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A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1989.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; *Chemical Processes; Estuaries.*

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

CONTRASTING HYDROLOGIC PROCESSES ON SEMIARID AND HUMID WATERSHEDS,
Washington Univ., Seattle.
T. W. Cundy.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-004128. Price codes: A03 in paper copy, A01 in microfiche. Report No. DOE/ER--0354, October 7, 1987. 16p, 4 fig, 2 tab, 2 ref.

Descriptors: *Hydrologic studies, *Semiarid climates, *Watersheds, *Humid climates, *Data acquisition, *Remote sensing, Computer programs, REFLEX, Hydrologic data.

The goal of this seminar presentation was to compare and contrast hydrologic processes and the applicability of remote sensing in solving hydrologic problems on humid and semiarid watersheds. In meeting this goal the seminar also served to clarify some of the major challenges facing the REFLEX (Remote Fluvial Experiments) program; a principal problem being the ability to utilize remote sensing information and field hydrologic data to move from one spatial scale to another. This is currently a topic of significant interest in the hydrologic community. If REFLEX can provide even a small step toward accomplishing this it would be a major contribution in theoretical and applied hydrology. (Lantz-PTT)
W89-03359

STOCHASTIC MODELS FOR ESTIMATION OF EXTREME POLLUTION FROM URBAN RUNOFF.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5B.
W89-03439

CALIBRATION AND COUPLING OF CONCEPTUAL RAINFALL-RUNOFF/CHEMICAL FLUX MODELS FOR LONG-TERM SIMULATION OF CATCHMENT RESPONSE TO ACIDIC DEPOSITION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. J. Cosby, G. M. Hornberger, D. M. Wolock, and P. F. Ryan.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 151-160, 2 fig, 3 tab, 17 ref.

Descriptors: *Systems analysis, *Calibrations, *Rainfall-runoff relationships, *Hydrologic models, *Simulation, *Acid rain, *Model studies, Calibrations, Rainfall, Estimating equations, Water quality, Soil chemistry, Carbon dioxide.

A conceptual rainfall-runoff model (TOPMODEL) and a conceptual chemical flux model (MAGIC) were coupled to examine the long-term response of a simulated catchment to acidic deposition. Problems arising from different temporal and spatial scales in the models precluded a direct coupling of the models and required stagewise calibration using different loss functions. The calibration procedure was tested using data from an intensively studied catchment in the U.S. Uncertainty in identification of the calibrated parameters was examined using estimation error variances based on approximations of the Hessian matrices of the model loss functions. The sensitivity of optimal parameter values to small changes in inputs was also analyzed by performing the calibrations on a subset of the observed data as well as the entire record of observations. The analyses indicated that most parameters were well constrained by the calibration procedure. Several parameters related to CO2 partial pressure and soil cation selectivity were, however, covariant and not well determined, suggesting that either additional data or a change in model structure is needed. (See also W89-03679) (Author's abstract)
W89-03694

TWO-DIMENSIONAL SHALLOW WATER FLOW IDENTIFICATION,
Ministerie van Verkeer en Waterstaat, The Hague (Netherlands). Dienst Informatieverwerking.
A. W. Heemink.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-181177. Price codes: E03 in paper copy, A01 in microfiche. 45p, 12 fig, 26 ref.

Descriptors: *Flow profiles, *Shallow water, *North Sea, *Model studies, *Storm surges, *Rainfall-runoff relationships, Mathematical studies, Filters, Water level, Stochastic analysis, Mathematical models, Hydrologic studies.

A discrete time-invariant Kalman filter for the identification and prediction of two-dimensional shallow water flow using observations of the water-level registered at some locations, has been developed. The filter is based on a set of difference equations derived from the linear two-dimensional shallow water equations using a finite difference scheme. By introducing a system noise process, the difference equations can be embedded into a stochastic environment. A Chandrasekhar-type algorithm was used to obtain the steady-state filter. In this way, the fact that the noise is less spatially variable than the underlying process can be exploited to reduce the computational burden. The capabilities of the filter are illustrated by applying it to the six hours ahead prediction of storm surges in the North Sea. The results show excellent filter performance and, with respect to the results of the underlying deterministic model which were achieved without using the water-level measurements available, the improvement obtained by filtering the measurements is substantial. (Author's abstract)
W89-03740

WATER RESOURCES INVENTORY OF CONNECTICUT. PART 10: LOWER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
L. A. Weiss, J. W. Bingham, and M. P. Thomas.
Connecticut Water Resources Bulletin No. 31, 1982. 85p, 57 fig, 30 tab, 5 plates, 152 ref.

Descriptors: *Connecticut River Basin, *Water resources data, *Data collections, *Groundwater supply, *Ecological effects, Rainfall-runoff relationships, Groundwater quality, Water quality, Aquifers, Geohydrology, Iron, Manganese, Turbidity, Color, Taste.

The lower Connecticut River basin study area in south-central Connecticut includes 639 sq mi and is drained principally by the Connecticut River and by seven smaller streams that flow directly to Long Island Sound between the West River on the west and the Connecticut River on the east. Precipitation averages 47 inches/yr and provides an abundant supply of water. About 20 inches returns to the atmosphere as evapotranspiration, and the remainder either flows directly to streams or percolates to the water table, eventually discharging to Long Island Sound. Stratified drift is the chief aquifer capable of large sustained yields of water to individual wells. Yields of 53 inventoried screened wells tapping stratified drift range from 2 to 1,570 gallons/minute (gpm); median yield is 397 gpm. Till is widespread and generally provides only small amounts of water. Bedrock aquifers underlie the entire area and include sedimentary and crystalline (igneous and metamorphic) rock types. These aquifers supply small and usually reliable quantities of water to wells and are the chief source of water for many rural homes and farms. About 90% of the wells tapping bedrock yield at least 2 gpm. The median yields from wells tapping aquifers in sedimentary, igneous, and metamorphic rocks are 11, 8, and 6.5 gpm, respectively. The chemical and physical (turbidity, color, taste, and sediment load) quality of water is good. The quality of water in stratified-drift and crystalline-rock aquifers is generally better than that in the sedimentary-rock aquifers. Iron and manganese occur in objectionable concentrations in places, particularly in water from streams draining swamps and in water from aquifers either rich in Fe and Mn-bearing minerals or where the reducing environment for solution of these minerals is favorable. Human activities and tidal influence along the coast have modified the quality of water in much of the study area. The greatest influence from human activities has been in the northwestern part, in the Mattabesset River basin. (Lantz-PTT)
W89-03772

ESTIMATING RUNOFF VOLUMES FROM FLAT, HIGH-WATER-TABLE WATERSHEDS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W89-03833

NEW ALGORITHM FOR THREE-DIMENSIONAL TIDAL AND STORM SURGE COMPUTATIONS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Mathematical Sciences.
R. W. Lardner, and H. M. Cekirge.
Applied Mathematical Modelling AMMODL, Vol. 12, No. 5, p 471-481, October 1988. 6 fig, 36 ref. King Fahd University of Petroleum and Minerals Research Institute Contract No. 24079.

Descriptors: *Mathematical models, *Algorithms, *Storm surges, *Storm tides, *Hydrodynamics, Numerical analysis, Eddies, Finite difference methods, Estuaries, Mathematical equations.

A computational algorithm is proposed for the solution of the hydrodynamical equations appropriate for motions in shallow seas and estuaries. The surface elevation and depth-averaged velocity components are first computed using one of the standard two-dimensional algorithms for the solution of the shallow-water equations. These values are then used to compute the vertical profile of the velocity field by solving the two horizontal momentum equations. These equations form a coupled parabolic system, and a generalized Crank-Nicholson scheme is developed to solve them. In the case of constant eddy viscosity this scheme can be shown to be unconditionally stable, so the only stability restriction is the usual CFL condition on the shallow-water equations. Thus the time step is limited only in terms of the horizontal grid spacing, not by the vertical spacing. The algorithm is tested on a model problem previously used involving the development of circulation in a rectangular sea under the influence of a constant surface windshear. The velocity profiles at various times are presented, and the final steady-state flow agrees very well with that computed previously. For constant eddy-viscosity the complete three-dimensional computation is only twice as slow as the two-dimensional computation that forms part of it. (Author's abstract)
W89-03931

HYDROLOGY OF AREA 57, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, UTAH AND ARIZONA,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04066

HYDROLOGY OF AREA 51, ROCKY MOUNTAIN COAL PROVINCE, WYOMING AND MONTANA,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04067

HYDROLOGY OF AREA 52, ROCKY MOUNTAIN COAL PROVINCE, WYOMING, COLORADO, IDAHO, AND UTAH,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04068

HYDROLOGY OF AREA 47, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NORTH DAKOTA, SOUTH DAKOTA, AND MONTANA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04069

SIMULATION OF RAIN FLOODS ON WILLOW CREEK, VALLEY COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04090

HYDROLOGIC RECONNAISSANCE OF THE CHILKAT RIVER BASIN, SOUTHEAST ALASKA (WITH SPECIAL REFERENCE TO THE ALASKA CHILKAT BALD EAGLE PRESERVE),
Geological Survey, Anchorage, AK. Water Resources Div.
E. F. Bugliosi.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4023, 1988. 38p, 25 fig, 6 tab, 15 ref.

Descriptors: *Water resources data, *Hydrologic data, *Streamflow, *Alaska, *Chilkat River, Springs, Birds(Bald eagles), Low flow, Alluvial fans, Salmon, Tsirku River, Data collections.

The Chilkat River Basin of Alaska is characterized by glaciers, highly dissected mountains with steep-gradient streams, and braided rivers in broad, alluvium-filled valleys. Orographic effects and a wide seasonal range in temperature cause variations in the amount and distribution of precipitation, and thus in the resulting runoff and streamflow. Seeps and springs flowing from alluvial fans contribute to streamflow year round. Infiltration of water from the Tsirku River and its distributary channels is the most important source of groundwater recharge on the river's alluvial fan, 20 mi north of Haines. Groundwater discharge along the toe of the fan maintains open leads in a reach of the Chilkat River downstream from the fan. This ice-free reach provides spawning habitat for a late run of salmon, which in turn attracts the world's largest concentration of bald eagles (more than 3,000 birds). Both surface and groundwater are a calcium bicarbonate type. Stream samples had dissolved-solids concentrations < 115 mg/L; values for groundwater were slightly greater. The glacier-fed Chilkat, Tsirku, and Klehini Rivers carry large concentrations of suspended sediment during periods of high flow. (USGS)
W89-04116

MODELING OF THE INFILTRATION PROCESS IN ARID ZONES FOR IRRIGATION PROJECT PURPOSES WITH THE AID OF THE 'SYSTEME HYDROLOGIQUE EUROPEEN' (SHE),
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France). Applied Mathematics Dept.
For primary bibliographic entry see Field 3F.
W89-04263

ROLE OF HYDROLOGICAL FORECASTS AND RIVER FLOW MODELLING IN RATIONAL AGRICULTURAL WATER MANAGEMENT IN THE PERSPECTIVE OF A CLIMATE CHANGE - A CASE STUDY OF THE RIVERS UPPER NILE AND NIGER,
World Meteorological Organization, Geneva (Switzerland). Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6A.
W89-04277

2B. Precipitation

SPATIAL ESTIMATION OF ANNUAL WET ACID DEPOSITION USING SUPPLEMENTAL PRECIPITATION DATA,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W89-03356

VARIATION OF LONG-LIVED RADON DAUGHTERS IN PRECIPITATION,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-03399

LOW LATITUDE INFLUENCE ON WINTER RAINFALL IN VICTORIA, SOUTH-EASTERN AUSTRALIA: I. CLIMATOLOGICAL ASPECTS,
Melbourne Univ., Parkville (Australia). Dept. of Meteorology.
W. J. Wright.
Journal of Climatology JOUCD2, Vol. 8, No. 5, p 437-462, September-October 1988. 11 fig, 2 tab, 50 ref.

Descriptors: *Meteorological data collection, *Weather patterns, *Rainfall, *Australia, *Climatology, Precipitation, Clouds, Synoptic analysis, Moisture, Tropical regions, Seasonal variation.

A synoptic mechanism is proposed for a long-known, but synoptically little-studied, tropical influence on northern Victorian rainfall during the winter half-year, based on results from a 12 winter (June-September) climatology covering the period 1971-1982. It is shown that heavy precipitation events in northern Victoria commonly result from interactions between cloud masses originating at low latitudes within the Australian region, and high amplitude frontal troughs moving within the midlatitude westerly flow. Most of the precipitation falls ahead of surface cold fronts, within moist northerly airstreams. The low latitude cloud masses involved may originate in several ways, but most commonly take the form of so-called northwest cloudbands originating over the tropical Indian Ocean northwest of Australia. Interacting frontal systems contribute some 50% of northern Victoria's winter precipitation, but the presence of a relatively modest topographical barrier across the center of the State substantially reduced their contribution to total rainfall in southern and southeastern Victoria. A distinction is made between these interacting (or I) fronts, and noninteracting (NI) fronts: although I fronts occur less frequently than NI fronts, they produce considerably heavier rainfall. Analysis of the moisture content of prefrontal airmasses reveals that the airmasses ahead of I fronts are generally much moister than those ahead of NI fronts, and that the heavier I frontal rainfall is largely attributable to this moisture. An investigation is also made of moisture-rainfall relationships for cold lows, also a significant source of precipitation throughout Victoria. (Author's abstract)
W89-03453

DAILY RAINFALL OVER NORTHERN AUSTRALIA: DEVIATIONS FROM THE WORLD PATTERN,
University of New England, Armidale (Australia). Dept. of Geography and Planning.
I. J. Jackson.
Journal of Climatology JOUCD2, Vol. 8, No. 5, p 463-476, September-October 1988. 5 fig, 9 tab, 11 ref.

Descriptors: *Weather patterns, *Rainfall, *Tropical regions, *Australia, Regression analysis, Soil erosion, Tropical cyclones, Rainfall intensity, Rainfall distribution, Weather data collections.

In an examination of relationships between monthly rainfall, raindays and mean daily rainfall intensity in the tropics, two Australian stations showed a consistent pattern of deviations from the worldwide regression equations. Using data from some 50 stations, it is shown that this pattern applies generally over northern Australia. Rainfall is much more concentrated, with fewer raindays and higher mean daily intensities, than would be predicted from monthly totals and the worldwide tropical regressions. This marked concentration will have varied implications for hydrology, soil erosion and agriculture. The importance of tropical cyclones and other closed low pressure systems over northern Australia provides a reasonable explanation of the deviations, with support from some other tropical regions. However, a simple distinction between tropical cyclonic and non-cyclonic areas is inadequate to explain patterns on a worldwide basis. (Author's abstract)
W89-03454

TROPICAL CIRCULATIONS AND THE ASSOCIATED RAINFALL ANOMALIES DURING TWO CONTRASTING YEARS,
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
M. T. Kayano, V. B. Rao, and A. D. Moura.
Journal of Climatology JOUCD2, Vol. 8, No. 5, p 477-488, September-October 1988. 8 fig, 18 ref.

Descriptors: *Rainfall distribution, *El Nino, *Rainfall, *Tropical regions, South America, Climatology, Monsoons, Weather patterns.

The severe drought conditions observed during 1983 over a large extent of tropical lands were associated with the 1982-1983 El Nino event. In contrast, above normal rainfall was observed over these areas during 1984. The tropical circulations have been examined for these two contrasting years. The intensity and location of the rising and sinking motions were consistent with the rainfall anomalies and also with the outgoing longwave radiation anomalies. It was found that the north-south migration of the tropical trough played an important role in modulating the tropical rainfall during these two years. In the context of the currently acceptable theoretical motions of the tropical circulation, some of the observed characteristics could be explained in terms of an atmospheric response to tropical heat sources. The results suggest that seasonal changes were involved in the 1982-1983 El Nino collapse. (Author's abstract)
W89-03455

SEASONAL FORECASTING OF THE KENYA COAST SHORT RAINS, 1901-84,
University of East Anglia, Norwich (England). Climatic Research Unit.
G. Farmer.
Journal of Climatology JOUCD2, Vol. 8, No. 5, p 489-497, September-October 1988. 4 fig, 3 tab, 24 ref.

Descriptors: *Rainfall, *Kenya, *Weather Forecasting, Seasonal variation, Time series analysis, Regression analysis, Coasts, Climatology, Africa, Monsoons.

A rainfall anomaly time series for the Short Rains (September to December) on the Kenyan coast (KCS) is derived for the period 1901-1984. On the year-to-year time scale a high degree of association can be seen between high/low extremes of a Southern Oscillation Index (SOI) and negative/positive anomalies in the KCS series. The SOI-rainfall relationship is investigated seasonally with KCS lagging the SOI series by one, two and three seasons. A decay of the correlation with increasing lag can be seen. When the time series is divided into 1901-1942 and 1943-1984 the relationships are stronger in the more recent period. Some forecasting skill does seem possible using the June to August (JJA) SOI to predict the September-December rains. While the 1901-1942 period shows a skill not much improved from using a simple climatological forecast, the 1943-1984 period shows a much stronger relationship. There may well have been a change in some underlying climate mechanism between the early decades of this century and the more recent decades. (Author's abstract)
W89-03456

RELATIONSHIP OF THE INDIAN MONSOON RAINFALL TO THE NORTHERN HEMISPHERIC 700 MB HEIGHT TENDENCY,
Maryland Univ., College Park. Dept. of Meteorology.
D. A. Mooley, and D. A. Paolino.
Journal of Climatology JOUCD2, Vol. 8, No. 5, p 499-509, September-October 1988. 3 fig, 3 tab, 18 ref. NSF Grant ATM 8414660 and NASA Global Weather Program NASA-NAGW-558.

Descriptors: *Athmospheric pressure, *Monsoons, *Rainfall, *Monte Carlo method, *India, Weather forecasting, Regression analysis.

The fields of northern hemispheric 700 mb height tendency from January to April and from March to April are examined for the period 1950-1984 in relation to Indian monsoon (June to September) rainfall. The height tendency from January to April at three locations (near Pacific high and near Siberian high at sea level, and over southwest U.S.A) and from March to April at one location (about 50 degrees longitude west of sea level Aleutian low) are found to be significantly related to the Indian monsoon rainfall. These four variables are generally not inter-related among themselves, and are not significantly related to the April 500 mb ridge, the tendency of the Southern Oscillation Index (SOI), and the eastern equatorial Pacific sea surface temperature tendency from DJF to MAM season. The best among the height tendency variable is the height tendency from January to April near sea level Pacific high. This variable is not as good as the tendency of SOI; however, when used in conjunction with April 500 mb ridge and the tendency of SOI, it makes a highly significant contribution to the explained variance and improves the forecasts for independent years as judged by different measures of assessment. This height tendency thus makes a useful additional predictor for the Indian monsoon rainfall. The mechanism of the influence of the development of the Pacific high on the Indian monsoon rainfall is not clear. It is, however, possible that the linkage between the development of the Pacific high and the Indian monsoon rainfall is through linkage of the Pacific high with the development of the summer season trough of low pressure over the Indian sub-continent. This, however, needs to be investigated. (Author's abstract)
W89-03457

ANNUAL CYCLE, QUASI-BIENNIAL OSCILLATION, AND SOUTHERN OSCILLATION IN GLOBAL PRECIPITATION,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
K. M. Lau, and P. J. Sheu.
Journal of Geophysical Research JGRDE3, Vol. 93, No. 9, p 10975-10988, September 1988. 12 fig, 4 tab, 45 ref. NSF Grant No. ATM-8414834.

Descriptors: *Precipitation, *Climatology, *Rainfall distribution, Spatial distribution, Temporal distribution, Rainfall, Hydrologic models, Tropical regions, Seasonal variation.

The spatial and temporal variations in global precipitation associated with the annual cycle (AC), the tropospheric quasi-biennial oscillation (QBO), and the Southern Oscillation (SO) are studied using 80 years (1901-1980) of global station rainfall data. The spatial scale and migration of the major climatological precipitation regimes are identified from the zeroth and first harmonic of the rainfall data. From the annual mean anomaly it was found that the dominant global precipitation pattern fluctuates irregularly, with 2-to 5-year periods associated with the SO. This pattern is characterized by a center of action in the form of an east-west dipole located over the equatorial central Pacific and the maritime continent of Indonesia. The occurrence of an El Nino/Southern Oscillation (ENSO) corresponds to an extreme phase of this dipole anomaly. Viewed in terms of the total rainfall amount (including the AC), the large rainfall anomalies that occurred during ENSOs represent major dislocations of the normal global rainfall pattern, affecting regions of the western Pacific/maritime continent and, to a lesser extent, China, Brazil, Argentina, southeast Africa, and southeast United States. Using the monthly rainfall anomaly, the same pattern again emerges as the dominant mode of variation. However, the temporal variation shows, in addition to the SO time scale, a distinct QBO signal. Using various time series analyses techniques, it was found that the QBO appears to be well correlated with the square of the SO signal. This result is also confirmed by bispectral analyses. The best correlation appears to occur during ENSO, with an apparent phase locking between the QBO and SO. A nonlinear interaction mechanism consistent with these results is illustrated by a conceptual model. The model suggests that the QBO may be an even more fundamental long-term oscillation of the tropical ocean-atmosphere system than the SO. ENSO-like cycles can arise from a basic 2 year oscillation in the tropical ocean-atmosphere system through its lagged effect from one year to the next. In addition, long-term trends and amplitude modulation of the QBO can also arise from this effect. The role of the possible influence of the AC and other factors involved in this QBO-SO interaction is also discussed. (Author's abstract)
W89-03479

EVOLUTION OF THE KINEMATIC STRUCTURE AND PRECIPITATION CHARACTERISTICS OF A MESOSCALE CONVECTIVE SYSTEM ON 20 MAY 1979,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
A. I. Watson, J. G. Meitin, and J. B. Cunning.
Monthly Weather Review MRWEAB, Vol. 116, No. 8, p 1555-1567, August 1988. 15 fig, 2 tab, 34 ref.

Descriptors: *Convective precipitation, *Kinematic waves, *Mathematical models, Radar, Convection, Squalls, Thunderstorms, Rainfall, Hydrologic budget.

The relationship of vertical motion to the occurrence of precipitation from the convective and stratiform regions of a mesoscale convective system (MCS) is presented. On 20-21 May 1979, an MCS developed over portions of Oklahoma, Texas, and Arkansas. The uniqueness of this system was its lack of squall-line characteristics and development of a large stratiform precipitation region. The evolution of the system is detailed by rawinsonde observations, radar cross sections, 15-min composite analyses of six NWS WSR-57 radars, and by raingages. The genesis stage of the MCS was described by strong convection along an east-west cold front that was reinforced by outflow generated by two mesoscale convective complexes (MCCs) that formed the night before in Kansas and Missouri. The mature stage of the MCS was characterized by the development of a large stratiform precipitation region while convection was limited to the southern and eastern flanks of the system. Finally, in the dissipative stage, a moderate north-south squall line that developed over west Texas in the afternoon moved rapidly to the east apparently associated with a short-wave aloft and appeared to sweep the entire system out of Oklahoma. A modified Cheng and Houze technique is applied to the radar composites to determine stratiform and convective regions utilizing temporal as well as areal considerations. For the system as a whole, the stratiform region generated 30-50% of the total precipitation. The vertical-motion profiles hold the key to the precipitation characteristics over the storm-scale network. The genesis period was characterized by a strongly convective profile. As the system matured, low-level upward motion ceased, while middle-level upward motion was sustained. A large area of stratiform rain developed as the deep convection weakened. Water-budget considerations suggest that the stratiform region was maintained by a combination of mesoscale middle-level updraft and by horizontal transfer of convective debris. (Author's abstract)
W89-03482

APPLICATION OF THE SEMI-LAGRANGIAN METHOD TO A SPECTRAL MODEL OF THE SHALLOW WATER EQUATIONS,
Canadian Meteorological Centre, Dorval (Quebec).
H. Ritchie.
Monthly Weather Review MRWEAB, Vol. 116, No. 8, p 1587-1598, August 1988. 11 fig, 21 ref, append.

Descriptors: *Weather forecasting, *Numerical analysis, *Mathematical models, Spectral analysis, Advection, Mathematical studies, Algorithms, Prediction.

Previous tests with grid-point numerical weather prediction models have shown that semi-Lagrangian schemes permit the use of time steps that are much larger than those permitted by the Courant-Friedrichs-Lewy (CFL) stability criterion for the corresponding Eulerian models, without reducing the accuracy of the forecasts. Thus model efficiency is improved because fewer time steps are needed to complete the forecast. In a first step to see if similar results can be achieved in spectral models. In a previous study, were interpolating and noninterpolating semi-Lagrangian treatments of advection to the problem of simple advection by a steady wind field on a Gaussian grid. This present paper combines these treatments of advection with the semi-implicit scheme in a spectral model of the shallow water equations expressed in vector momentum form. Model formulations are presented and intercomparison experiments are performed. It is shown that both interpolating and noninterpolating semi-Lagrangian schemes can be applied accurately and stably to a spectral model of the shallow water equations with time steps that are much larger than the CFL limit for the corresponding Eulerian model. (Author's abstract)
W89-03483

SEASONAL VARIATIONS IN THE DIURNAL CHARACTERISTICS OF HEAVY HOURLY PRECIPITATION ACROSS THE UNITED STATES,
Michigan State Univ., East Lansing. Dept. of Geography.
J. A. Winkler, B. R. Skeeter, and P. D. Yamamoto.
Monthly Weather Review MRWEAB, Vol. 116, No. 8, p 1641-1658, August 1988. 10 fig, 2 tab, 44 ref.

Descriptors: *Precipitation, *Diurnal distribution, *Seasonal variation, Precipitation intensity, Geography, Spatial distribution, Temporal distribution.

Hourly precipitation data from 1967 to 1983 for the coterminous United States were harmonically analyzed in order to document the diurnal variability of several categories of heavy hourly precipitation during winter, spring, summer, and autumn. The analysis revealed that the diurnal characteristics of hourly precipitation vary considerably with season, geographic region, and precipitation intensity. During winter and spring, a weak late-morning frequency maximum prevails for the lightest (2.5-6.2 mm/h) precipitation category. As intensity increases (to 6.3-12.6, 12.7-25.3, and $>$ or $=$ 25.4 mm/h), the amplitude of the diurnal cycle also increases, and a nocturnal maximum becomes apparent across much of the eastern and central United States. In summer, the diurnal cycle is strongly modulated for all categories. The nocturnal region decreases in areal extent at this time of year, as an afternoon maximum becomes established across the southern and eastern states. In autumn, the nocturnal region again increases in size, although the area it encompasses is smaller than that during winter and spring. Seasonal variations in the semidiurnal cycle are more ambiguous due to the dominance of the diurnal cycle at most locations, although secondary maxima and minima are most likely south of the Great Lakes and in eastern and central Texas. Comparison with the results of previous studies indicates that different definitions of winter, spring, summer, and autumn can lead to divergent descriptions of the diurnal cycle of hourly precipitation. (Author's abstract)
W89-03484

SUMMERTIME WEATHER AND ITS PREDICTABILITY IN THE EASTERN ORANGE FREE STATE,
Water Research Commission, Pretoria (South

Africa).
D. Hudak.
South African Journal of Science, Vol. 84, No. 1, p 39-44, January 1988. 3 fig, 5 tab, 15 ref.

Descriptors: *Weather forecasting, *Weather patterns, *Precipitation, *Meteorology, *Climatology, *South Africa, *Convective precipitation, Hail, Rainstorms, Weather modification.

Summertime weather observations from 1977-83 in the eastern Orange Free State were examined and the weather forecasts evaluated. The observations showed that 67% of the days were of a convective nature, 25% were fair weather, and 8% were general rain days. Of the convective days, about 1/4 were associated with significant rainfall, 1/4 with widely scattered light showers, and the remaining half with showers and isolated thunderstorms. A notable increase in the incidence of hail in December followed by a rise in general rain days in January reflect the intrusion of maritime tropical air into the area. The forecasting accuracy in distinguishing among the different kinds of days was 0.87 with a predictive performance of 0.61. This kind of forecasting is shown to be a valuable tool in the planning of weather modification operations. The reliability and consistency in these forecasts indicates that a limit of predictability may have been reached. The forecasting accuracy in distinguishing among the three types of convective days was 0.64 with a predictive performance of 0.27. In this case biases in forecasts in November and March (the transition months between winter and summer circulations) were noticeable. (Author's abstract)
W89-03521

PRECIPITABLE WATER AND SURFACE DEW-POINT RELATIONSHIPS IN DIFFERENT AIR-FLOW CONDITIONS AT CAPE TOWN,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Geography.
O. S. McGee.
South African Journal of Science, Vol. 84, No. 1, p 64-65, January 1988. 5 fig, 1 ref.

Descriptors: *Precipitation, *Water vapor, *Dewpoint, *South Africa, *Meteorology, Radiosondes, Cape Town, Airflow, Wind.

An analysis of published data collected in South Africa suggested that the relationships between precipitable water vapor, as calculated from radiosonde ascent, and the surface dewpoint might differ according to the synoptic conditions of airflow regimes. This report provides evidence of this airflow dependence from daily radiosonde ascents at 13h30 over 10 years from Cape Town. The data confirm the suggestion that different airflow types, with different mechanisms causing vertical mixing, might result in different relationships between surface moisture parameters and the total water vapor content of the air. It is stressed that it is the vapor content and not the amount transported that is being considered, and also that winds classified as being from a particular direction might represent different synoptic conditions. (Sand-PTT)
W89-03522

CALIBRATION AND COUPLING OF CONCEPTUAL RAINFALL-RUNOFF/CHEMICAL FLUX MODELS FOR LONG-TERM SIMULATION OF CATCHMENT RESPONSE TO ACIDIC DEPOSITION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2A.
W89-03694

NUMERICAL SIMULATIONS OF THE DEVELOPMENT OF MOUNTAIN CUMULUS CLOUDS,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. M. Banta, and K. R. Hanson.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A190 634. Price codes: A02 in paper copy, A01 in microfiche. 9p, 10 fig, 19 ref.

Descriptors: *Mathematical models, *Model studies, *Mountains, *Simulation analysis, *Cloud formation, Air circulation, Air entrainment, Clouds, Air temperature, Precipitation.

The initiation and development of shallow cumuli forming over a heated mountain ridge are sensitive to the magnitude of the surface heat flux and to the presence of domain-scale convergence in the boundary layer. A two-dimensional, fine resolution (200 m horizontal by 100 m vertical) version of the cloud model, showed that a surface kinematic heat flux of 17 K cm/sec was insufficient to produce cloud, but a larger heat flux of 25 K cm/sec did generate shallow clouds. Furthermore, a domain-scale, boundary-layer convergence of 0.0001/sec added to the lower heat flux run produced deeper (but still shallow) clouds sooner than the higher heat flux case without convergence. The lack of precipitation in these clouds results from the model correctly predicting low liquid water contents and low cloud activity. (Author's abstract)
W89-03749

INTERNATIONAL METEOROLOGICAL INSTITUTE IN STOCKHOLM ANNUAL REPORT, JULY 1986-JUNE 1987.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 6E.
W89-03754

INTERIM ASSESSMENT: THE CAUSES AND EFFECTS OF ACIDIC DEPOSITION. VOLUME 1: EXECUTIVE SUMMARY.
National Acid Precipitation Assessment Program, Washington, DC. Office of the Director of Research.
For primary bibliographic entry see Field 5B.
W89-03774

RELATIONSHIP BETWEEN PRECIPITATION QUALITY, SHALLOW GROUND-WATER GEOCHEMISTRY, AND DISSOLVED ALUMINUM IN EASTERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-03782

THEORETICAL MODEL OF THE PROCESS OF RAINFALL INTERCEPTION IN FOREST CANOPY,
Beijing Coll. of Forestry (China). Dept. of Basic Courses.
L. Jiagang.
Ecological Modelling ECMOOT, Vol. 42, No. 2, p 111-123, August 1988. 3 fig, 24 ref.

Descriptors: *Mathematical models, *Rainfall, *Throughfall, *Forest hydrology, *Canopy, *Interception, *Evaporation, Ecosystems.

A theoretical model describing the process of rainfall interception and evaporation in a forest canopy is presented. The new model localizes water balance between rainfall, throughfall, evaporation and changes in storage on every infinitely thin layer of canopy. Consequently, shading relationships between different layers of canopy are considered. The model is closely connected with canopy structure and its physical nature without empirical coefficient determined by fitting data. The new model provides more information and detail for interception and evaporation process. An illustration shows a vivid process evolving, with rational results. (Author's abstract)
W89-03825

ROLES OF RAINFALL AND RUNOFF IN THE SEDIMENT TRANSPORT CAPACITY OF INTERRILL FLOW,
Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 2J.
W89-03831

REVISED SLOPE STEEPNESS FACTOR FOR THE UNIVERSAL SOIL LOSS EQUATION,
Agricultural Research Service, Pullman, WA.
For primary bibliographic entry see Field 2J.
W89-03832

SIZE DISTRIBUTION OF SEDIMENT AS AFFECTED BY SURFACE RESIDUE AND SLOPE LENGTH,
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 2J.
W89-03835

EXCESS NITROGEN DEPOSITION: ISSUES FOR CONSIDERATION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 5C.
W89-03873

RESPONSE TO HEAVY NITROGEN APPLICATIONS IN FERTILIZER EXPERIMENTS IN BRITISH FORESTS,
Aberdeen Univ. (Scotland). Dept. of Forestry.
For primary bibliographic entry see Field 5C.
W89-03874

DROP IMPACT ENERGY: SOIL EXCHANGEABLE SODIUM PERCENTAGE INTERACTIONS IN SEAL FORMATION,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 2K.
W89-03904

ANALYSIS OF THE REAL-TIME MEASUREMENT OF THE PH OF RAINFALL AT PADOVA, ITALY: SEASONAL VARIATION AND METEOROLOGICAL ASPECTS,
Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
For primary bibliographic entry see Field 5B.
W89-03938

CHARACTERIZATION OF THE PRECIPITATION IN AN URBAN AREA OF THE PO VALLEY, ITALY,
Bologna Univ. (Italy). Dept. of Industrial Chemistry and Materials.
For primary bibliographic entry see Field 5B.
W89-03943

CHARACTERIZATION OF A RURAL AREA IN TERMS OF DRY AND WET DEPOSITION,
Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico.
For primary bibliographic entry see Field 5B.
W89-03960

RECONSTRUCTION OF PAST RIVER FLOW AND PRECIPITATION IN CANTERBURY, NEW ZEALAND FROM ANALYSIS OF TREE-RINGS,
Canterbury Univ., Christchurch (New Zealand). School of Forestry.
For primary bibliographic entry see Field 2E.
W89-03966

DIGITISING PLUVIOGRAPHS,
Meteorological Service, Wellington (New Zealand).
For primary bibliographic entry see Field 7B.
W89-03969

RECONNAISSANCE ISOTOPE STUDY OF WATERS IN THE KARST OF THE WESTERN TATRA MOUNTAINS,
Institute of Physics and Nuclear Techniques, Krakow (Poland).
For primary bibliographic entry see Field 2F.
W89-03974

EXPRESSION BY RECURRENCE OF SUCCESSIVE MOMENTS OF DISTRIBUTION FUNCTIONS OF DRY OR WET RUNS FOLLOWING AN UPPER ORDER MARKOV CHAIN (EXPRESSIONS RECURRENTES DES MOMENTS SUCCESSIFS DES FONCTIONS DE REPARTITION DES LONGUEURS DE SEQUENCES SECHES OU PLEUVIEUSES REGIES PAR UN PROCESSUS DE MARKOV D'ORDRE SUPERIEUR),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
C. Thirriot, and M. Arnaud.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 307, No. 4, p 361-366, June 28, 1988. 6 ref. English summary.

Descriptors: *Markov process, *Climatology, *Distribution, *Rainfall, *Water forecasting, Hydrology, Weather, Mathematical analysis.

Discrete Markov chains have been used to characterize pluviometric behavior and to simulate possible daily weather situations including meteorological hazards. The variability of the yearly number of rainy days given by low-order Markov chains is often less than historical variability. The variability is approximate in relation to the values of successive moments of the wet sequence length. The distribution of the sequence lengths is itself also useful, because it is like a more global climate characterization than the basic conditional probabilities represented by the Markov matrix coefficients. The distribution functions of runs of the same value of a Boolean variable drawn from an upper order Markov chain is derived; then a recurrence is found for the general formula of any order moment of this run length. The example of the drought length at meteorological stations in southwestern France is presented to illustrate the method. Results show that increasing the Markov order improves the proximity of theoretical and historical values. The use of fourth order chains is necessary for the distributions of the wet or dry sequence lengths. However, first or second order chains suffice for short length sequences. (Author's abstract)
W89-03986

NORTHEASTERN PACIFIC SUBMICROMETER AEROSOL AND RAINWATER COMPOSITION: A MULTIVARIATE ANALYSIS,
Washington Univ., Seattle. Dept. of Environmental Engineering and Science.
R. J. Vong, H.-C. Hansson, H. B. Ross, D. S. Covert, and R. J. Charlson.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 2, p 1625-1637, February 20, 1988. 5 fig, 7 tab, 59 ref. NSF Grant ATM-8318028.

Descriptors: *Water chemistry, *Aerosols, *Rain, *Chemical composition, *Cyclonic precipitation, *Chemistry of precipitation, Precipitation, Chemical properties, Statistical analysis, Ions, Sulfates, Nitrates, Hydrogen, Trace metals, Heavy metals, Metals, Lead, Copper, Cadmium, Manganese, Vanadium, Chromium, Nickel, Zinc, Ammonium.

Simultaneous observations of aerosol and rainwater composition were performed at a remote, mid-latitude, marine, land-based site to characterize the chemistry of Northeastern Pacific cyclonic frontal air masses. The measured concentrations of both the major ions (SO4(--), NO3(-), H(+)) and trace metals (Pb, Cu, Cd, Mn, V, Cr, Ni, Zn) in the submicrometer aerosol and rainwater were very low and similar to other remote locations indicating that the Lake Ozette sampling site is not dominated by human activity during on-shore air flow. Statistical analysis indicated that experimental uncertainty was not a significant source of variability and that rainwater solute has independent influences from sea salt and a component that included NH4(+), H(+), and SO4(--). Further investigation of source relationships was performed using 850 mbar trajectories, principal component analysis, partial least squares regression, enrichment factors, and scavenging ratios. Using these methods, it is concluded that submicrometer aerosol is the main precursor of trace metals and excess sulfate in Northeastern Pacific rain. (Author's abstract)
W89-03989

CHEMICAL CHARACTERISTICS OF PRECIPITATION IN NH3-AFFECTED AREAS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2K.
W89-03993

GAS-PHASE, CLOUD AND RAIN-WATER MEASUREMENTS OF HYDROGEN PEROXIDE AT A HIGH-ELEVATION SITE,
Tennessee Valley Authority, Muscle Shoals, AL. Air Quality Branch.
For primary bibliographic entry see Field 2K.
W89-03994

SIMULTANEOUS DETERMINATION OF UREA AND AMMONIA NITROGEN IN SOIL EXTRACTS AND WATER BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Farms of Texas, Alvin.
For primary bibliographic entry see Field 7B.
W89-04016

PROTOCOL FOR COLLECTING, PROCESSING, AND SHIPPING PRECIPITATION SAMPLES,
Geological Survey, Arvada, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04091

OPERATIONAL PROTOCOL FOR A RECORDING PRECIPITATION MONITOR,
Geological Survey, Arvada, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04092

CLIMATIC DATA FOR THE COTTONWOOD LAKE AREA, STUTSMAN COUNTY, NORTH DAKOTA, 1983,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04143

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1985,
Geological Survey, Lakewood, CO. Water Resources Div.
A. M. Sturrock, D. O. Rosenberry, and T. C. Winter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-607, 1987. 40p, 4 tab, 3 ref.

Descriptors: *Limnology, *Evaporation, *Climatic data, *Minnesota, Heat budget, Precipitation, Data collections, William Lake.

Research on the hydrology of Williams Lake, north-central Minnesota includes study of evaporation. Climatic data are presented for energy-budget and mass-transfer studies, including: water surface temperature, dry-bulb and wet-bulb air temperatures, wind speed, precipitation, and solar and atmospheric radiation. Data are collected at raft and land stations. (USGS)
W89-04151

SIMULATION OF SURFACE-MOISTURE EFFECTS ON THE GREAT PLAINS LOW-LEVEL JET,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-04283

MOBILE SOUNDING OBSERVATIONS OF A TORNADIC STORM NEAR THE DRYLINE: THE CANADIAN, TEXAS STORM OF 7 MAY 1986,
Oklahoma Univ., Norman. School of Meteorology.
For primary bibliographic entry see Field 7B.
W89-04284

VERTICAL STRUCTURES OF THE ATMOSPHERIC ELECTRICAL POTENTIAL GRADIENT AND THE BEHAVIOR OF THE PRECIPITATION CHARGES DURING SNOWFALLS NEAR THE GROUND SURFACE,
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
Y. Asuma, K. Kikuchi, T. Taniguchi, and S. Fujii.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 3, p 473-488, June 1988. 17 fig, 27 ref.

Descriptors: *Precipitation, *Electric potential, *Snow, *Atmospheric physics, Storms, Ions.

In order to examine the vertical structures of the atmospheric electrical potential gradient and the behavior of charges on precipitation particles during snowfalls in the lower atmospheric layer, tethered balloon observations were carried out with several observation stages secured to its tether. Simultaneously, data observed on the ground and on the roof of a nearby building were analyzed with the following results: (1) The mirror image relation between the polarities of the electric potential gradient and precipitation charges was always observed near the ground, but this relation was not always observed aloft. (2) Charges on snow particles were weaker aloft and stronger near the ground surface. (3) When the height of the cloud base was low and the highest observation stage of the tethered balloon was in the cloud or near the cloud base, snow particles were electrified weakly but positively at the highest stage; however, snow particles were electrified negatively near the ground and the electric potential gradient was positive on the ground. (4) The atmospheric electrical potential gradient on the ground was modified by the ions which were emitted by the corona discharge. (5) The most suitable electrification mechanism seems to be the Wilson's selective ion capture process below the cloud base. (White-Reimer-PTT)
W89-04285

POSSIBLE RAINFALL MECHANISM IN THE OROFURE MOUNTAIN RANGE, HOKKAIDO, JAPAN-THE RAINFALL ENHANCEMENT BY A TWO-LAYER CLOUD STRUCTURE,
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
K. Iwanami, K. Kikuchi, and T. Taniguchi.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 3, p 497-504, June 1988. 8 fig, 10 ref.

Descriptors: *Meteorology, *Precipitation, *Rainfall, *Rainfall intensity, *Clouds, *Radar, *Orographic precipitation, Weather, Cloud structure, Orofure Mountain Range, Hokkaido, Japan.

Radar observations were carried out on the Orofure mountain range in the Iburi sub-prefecture of Hokkaido from late August to early September in 1985 and 1986, in combination with rain gages and wind vanes and anemometers. Based on the interpretation of radar echoes and rainfall data an estimate was made of the rainfall intensities of two precipitating clouds in order to confirm the interaction between the two clouds using two different methods. Results obtained by both methods showed that the rainfall intensity when the upper precipitating cloud passed over the lower orographic cloud was larger than a simple summation of the rainfall intensity of each cloud. (White-Reimer-PTT)
W89-04286

COMPARISON OF RADAR AND GAUGE MEASUREMENTS OF RAINFALL OVER WALES IN OCTOBER 1987,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 7B.
W89-04292

FRACTAL CHARACTERIZATION OF INTERTROPICAL PRECIPITATIONS VARIABILITY AND ANISOTROPY (CARACTERISATION FRACTALE DE LA VARIABILITE ET DE

L'ANISOTROPIE DES PRECIPITATIONS INTERTROPICALES),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
P . Hubert, and J. Carbonnel.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 307, No. 8, p 909-914, August 30, 1988. 4 fig, 1 tab, 10 ref.

Descriptors: *Precipitation, *Rainfall, *Tropical regions, *Meteorology, Spatial variability, Anisotropy, Thiessen method, Weibull formula, Functional box counting method, Burkina Faso, Mali.

A single rain shower was observed June 12-13, 1986 in the vicinity of Ougadougou (Burkina Faso) from 111 gaging stations. The initial attempts to apply fractal techniques to a single rain shower suggest the following observations: (1) The multifractal structure of a single shower rainfall field was shown at mesoscale, from a limited set of data. (2) The network spatial outline imposes a detection limit characterized by a fractal dimension associated to a threshold. (3) An hyperbolic distribution, always associated with intermittent phenomena leading to fractal structures, can be fitted to rainfall heights. (4) It becomes workable to quantify variability and anisotropy of rainfall fields. Anisotropy seems to be controlled by the direction of movement of meteorological perturbations. (White-Reimer-PTT)
W89-04293

CHEMICAL COMPOSITION OF ATMOSPHERIC PRECIPITATION IN CZECHOSLOVAKIA, 1978-1984-II EVENT SAMPLES,
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5B.
W89-04299

MONTHLY HYDROGEN ION DEPOSITION MAPS FOR THE NORTHEASTERN U.S. FROM JULY 1982 TO SEPTEMBER 1984,
Consolidation Coal Co., Pittsburgh, PA.
For primary bibliographic entry see Field 5B.
W89-04300

USE OF KRIGING IN THE SPATIAL ANALYSIS OF ACID PRECIPITATION DATA,
ERT, Inc., Camarillo, CA.
For primary bibliographic entry see Field 7C.
W89-04301

PATTERNS OF CHERNOBYL FALLOUT IN RELATION TO LOCAL WEATHER CONDITIONS,
Goeteborg Univ. (Sweden). Dept. of Radiation Physics.
For primary bibliographic entry see Field 5B.
W89-04319

TOXIC CONTAMINANTS IN RAINFALL IN CANADA: 1984,
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 5B.
W89-04348

USING LIGHTNING FOR RAINFALL ESTIMATION IN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 750-755, May-June 1988. 6 fig, 18 ref, Contract no. 85091811.

Descriptors: *Climatology, *Rainfall, *Estimating, *Lightning, *Florida, Remote sensing, Mathematical equations, Meteorological data collections, Thunderstorms, Correlation analysis.

The objective of this study was to evaluate the feasibility of using lightning to quantify the area rainfall. Lightning and rainfall data collected during 1977 and 1978 by the Thunderstorm Research International Program located at the Kennedy Space Center were used in this study. The results showed that an increase of 1 lightning flash per minute appears to be equivalent to an increase in rainfall of about 1.6 mm. Also, each increment in maximum flashing rate (FM) per minute is likely to be equivalent to an increase of hourly rainfall by 1 mm. Using the FM appears to be a better tool for the area-average rainfall (RA) estimation than using average flashing rate. The RA can be predicted based on the FM with an equation of RA = 0.467 + 0.562 FM (r squared equals 0.74). (Author's abstract)
W89-04380

PHYSICAL AND CHEMICAL CHARACTERISTICS OF BULK PRECIPITATION IN THE RICHARDS BAY AREA, WITH SPECIAL REFERENCE TO LAKE MZINGAZI,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
C. G. M. Archibald, and M. S. Muller.
South African Journal of Science SAJSAR, Vol. 83, No. 11, p 700-704, November/December 1987. 2 fig, 4 tab, 26 ref.

Descriptors: *Acid rain, *Precipitation, *Physicochemical properties, *Lakes, *Industrial development, *South Africa, *Chemistry of precipitation, Sampling, Rain gages, Nutrients, Phosphorus, Nitrogen, Cations, Anions, Oligotrophic lakes, Atmospheric deposition.

The chemistry of bulk precipitation was measured at twelve stations in the Richards Bay region at monthly intervals. Station 3, the initial sampling site, was established in 1975 before major industrial development. Stations 1 and 2 were brought into operation during 1979, and Stations 4-12 were installed between June and September 1981. Samples were taken at most stations until February 1983. The temporal and spatial variation in atmospheric deposition rates of the major plant nutrients, cations, and anions were determined. At Station 3 the preindustrial background deposition rates of total phosphorus and total nitrogen averaged 0.47 kg P/ha/yr and 10.63 kg N/ha/yr. Phosphorus deposition rates increased markedly to a mean value of 1.39 kg/ha/yr during the startup phase of a phosphoric acid factory. Higher total phosphorus deposition rates were obtained at stations in close proximity to the industrial sites. Approximately 65-70% of the phosphorus and nitrogen load reached Lake Mzingazi--a natural oligotrophic freshwater system--as atmospheric deposition. Atmospheric deposition of phosphorus and nitrogen should be accounted for in the compilation of nutrient budgets of lakes. (Author's abstract)
W89-04438

2C. Snow, Ice, and Frost

MODELING SEASONALLY FREEZING GROUND CONDITIONS,
Bristol Univ. (England).
M. G. Anderson, and K. M. Sambles.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A190970. Price codes: A03 in paper copy, A01 in microfiche. 16p, 2 fig, 3 tab, 8 ref.

Descriptors: *Ground ice, *Frozen ground, *Frost, *Snow cover, *Model studies, Soil water, Mathematical models, Snow, Mathematical analysis, Freezing.

The spatial distribution of snowcover in areas experiencing seasonally frozen ground, is modeled through the use of SNOWM1, a model that is currently being developed in an attempt to mathematically model and thereby represent, the distribution of snow within a catchment over the snow season. Graphical representations of snowcover distribution over the snow season consider a plane model slope, the position and elevation of which are defined by the coordinates X, Y and Z (X and Z are the axes of rotation, for variations of slope angles and azimuths). The evolution in time of a snow profile at a given point on the slope is given along the T-axis. Snow profile variation with elevation is demonstrated for any time, along the Y-axis. It is for this situation that, when applied to a catchment, the model SNOWM1 is being developed. (See also W89-03331) (Lantz-PTT)
W89-03383

SNOW DISTRIBUTION ON CROP FIELDS,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
H. Scholten.
Agriculture, Ecosystems and Environment, Vol. 22/23, p 363-380, August 1988. 6 fig, 42 ref.

Descriptors: *Snow management, *Windbreaks, *Snow cover, *Cropland, *Soil-water-plant relationships, Precipitation, Soil water, Trees, Roots, Agricultural chemicals, Snow accumulation, Snow cover, Elm trees, Poplar trees, Ash trees.

In regions where snowfall provides a significant portion of the total annual precipitation, well-designed barriers will provide for uniform snow distribution and additional soil moisture. Artificial barriers effectively trap snow, but are cumbersome and expensive. Single-row tree windbreaks are the most effective, permanent barriers for uniform snow distribution. In general, the distance between a series of single-row field windbreaks should be 20 windbreak heights for effective cropland protection. The ideal tree species is a tall, fast-growing tree with a narrow and porous crown, non-spreading root system, non-brittle branches, minimum tendency to sprout, and high resistance to chemical spray damage. Since no one tree species possesses all these characteristics, the best-adaptable species should be selected and adjustments made through proper spacings and perhaps later pruning and thinning. An effective windbreak allows snow to filter through and settle uniformly over the cropland. Most tree species have crowns too dense for adequate filtering. Studies in Minnesota and North Dakota indicate that the dense, spreading crowns of Siberian elm (Ulmus pumila) are not conducive to filtering and therefore require a wider spacing and pruning from underneath. Some hybrid poplars (Populus spp.) are ideal for filtering, but brittle branches and self-pruning to excessive heights are disadvantages. Green ash (Fraxinus pennsylvanica) on a 3.0-m spacing is the best species in use today. (Author's abstract)
W89-03413

ACCUMULATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN AN URBAN SNOWPACK,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5B.
W89-03961

GEODETIC TRISECTION, ALTITUDE, AND ICE-RADAR SURVEYING TECHNIQUES USED AT KNIK GLACIER, ALASKA, AND SUMMARY OF 1979, 1980, AND 1981 DATA,
Geological Survey, Fairbanks, AK. Water Resources Div.
L. R. Mayo, and D. C. Trabant.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-685, 1982. 26p, 5 fig, 7 tab, 9 ref.

Descriptors: *Alaska, *Glaciers, *Remote sensing, *Radar, *Ice-dammed lakes, *Lake George, Knik Glacier, Lakes, Surveys.

Knik Glacier in south-central Alaska has the potential to reform Lake George, Alaska's largest glacier-dammed lake. Measurements of surface altitude, snow depth, terminus position, glacier speed, and ice depth are being made in an attempt to determine the mechanisms that could cause a significant re-advance of the glacier. New surveying and data reduction techniques were developed by the authors and employed successfully at Knik Glacier. These include precise geodetic surveying by the 'trisection' technique, calculation of surface altitude at a specially-fixed 'index point' from three point measurements on a rough, moving glacier

surface, and calculation of ice thickness from low frequency radar measurements. In addition, this report summarizes the data collected from 1979 to 1981 in support of this goal. (USGS)
W89-04095

INVESTIGATION OF THE ICE REGIME OF A STRETCH OF THE DAUGAVA RIVER UNDER REGULATED CONDITIONS,
For primary bibliographic entry see Field 8B.
W89-04225

FEATURES OF NATURAL ENVIRONMENT AND OCCURRENCE OF GROUNDWATER IN COLD ARTESIAN BASINS IN PERMAFROST AREAS, CHINA.
Heilongjiang Forestry Design Research Inst., Harbin (China).
For primary bibliographic entry see Field 2F.
W89-04323

2D. Evaporation and Transpiration

THEORETICAL MODEL OF THE PROCESS OF RAINFALL INTERCEPTION IN FOREST CANOPY,
Beijing Coll. of Forestry (China). Dept. of Basic Courses.
For primary bibliographic entry see Field 2B.
W89-03825

GENERAL MODEL OF FOREST ECOSYSTEM PROCESSES FOR REGIONAL APPLICATIONS: I. HYDROLOGIC BALANCE, CANOPY GAS EXCHANGE AND PRIMARY PRODUCTION PROCESSES,
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 2I.
W89-03826

DEVELOPMENT OF A SIMPLIFIED PLANT STOMATAL RESISTANCE MODEL AND ITS VALIDATION FOR POTENTIALLY TRANSPIRING AND WATER-STRESSED WATER HYACINTHS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W89-03995

QUASI-ANALYTICAL SOLUTIONS OF THE SOIL WATER FLOW EQUATION FOR PROBLEMS OF EVAPORATION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W89-04012

CLIMATIC DATA FOR MIRROR LAKE, WEST THORNTON, NEW HAMPSHIRE, 1985,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04045

CLIMATIC DATA FOR THE COTTONWOOD LAKE AREA, STUTSMAN COUNTY, NORTH DAKOTA, 1983,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04143

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1985,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2B.
W89-04151

EVAPOTRANSPIRATION AND MICROCLIMATE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE IN NORTHWESTERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
R. W. Healy, M. P. deVries, and A. M. Sturrock.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-301, 1987. 88p, 37 fig, 6 tab, 59 ref.

Descriptors: *Evapotranspiration, *Microclimate, *Illinois, Radioactive waste disposal, Bowen ratio, Hydrologic budget, Bureau County.

From July through June 1984, a study was made of the microclimate and evapotranspiration at the low-level, radioactive-waste disposal site near Sheffield, Bureau County, Illinois. Three methods were used to estimate evapotranspiration: energy-budget, aerodynamic-profile, and water-budget. Estimates by the first two methods were computed from hourly data, then summed by days and months. Yearly estimates for March through November, by these methods, were quite close-648 and 626 mm, respectively. Daily estimates ranged from 0 to 6 mm. The water-budget method produced only monthly estimates based on weekly or biweekly gamma-attenuation, soil-moisture-content measurements. The yearly evapotranspiration estimated by this method was 655 mm and included only the months of April through October. The yearly (March through November) average of 657 millimeters for the three methods was equivalent to 70% of precipitation and 75% of Penman potential evapotranspiration. Continuous measurements were made of incoming and emitted longwave and short-wave radiation, net radiation, soil-heat flux, soil temperature, horizontal windspeed, and wet- and dry-bulb air temperature. Windspeed and air temperature were measured at three heights. (USGS)
W89-04159

EVAPOTRANSPIRATION, PAN EVAPORATION AND SOIL WATER RELATIONSHIPS FOR WHEAT (TRITICUM AESTIVUM),
Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
P. Singh, and H. Wolkewitz.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 65-81, April 1988. 5 fig, 6 tab, 31 ref.

Descriptors: *Wheat, *Evapotranspiration, *Soil water, Pan evaporation, Plant growth, Plant development, Irrigation, Lysimeters.

Controlled irrigation experiments were conducted for wheat grown in lysimeters having undisturbed soil profiles and protected from rainfall by transparent roofs. Crop evapotranspiration during different crop growth stages and its relationships with class A pan evaporation and soil water parameters were studied. The casual evapotranspiration during different crop growth stages was greatly influenced by amount and time of irrigation. The ratio of the maximum evapotranspiration and class A pan evaporation increased linearly from germination to 46 days after sowing and remained constant at 1.45 from 46-76 days. Then the ratio decreased linearly towards the crop ripening. The actual evapotranspiration equalled the maximum evapotranspiration up to the critical value of relative soil water, and then the actual evapotranspiration decreased at a very fast rate with further decrease in relative soil water. The critical value of the relative soil water varied from 0.65 to 0.84 during the crop growth-stage periods late tillering-heading and dough ripe-ripe, respectively. (Author's abstract)
W89-04209

MICRO AND LARGE-SCALE PARAMETERS EVALUATION OF EVAPORATION FROM A LAKE,
Athens Univ. (Greece). Lab. of Meteorology.
C. Jacovides, G. Papaioannou, and P. Kerkides.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 263-272, June 1988. 5 fig, 28 ref.

Descriptors: *Lakes, *Lake evaporation, *Micrometeorology, *Evaporation, Evapotranspiration potential, Bowen ratio, Wind speed, Relative humidity, Heat flow, Radiation, Water temperature.

Selected measurements of micrometeorological quantities taken over a lake are presented. The measured quantities include horizontal and vertical components of the wind speed, readings of temperatures from wet and dry-bulb thermocouples, short-wave and long-wave incoming and out-going radiation fluxes, readings of water temperatures at three different depths in the lake, as well as readings of the water surface temperature. Direct outcome of the measurements are the sensible and latent heat fluxes as determined by the eddy correlation method. The calculation of the potential or reference evapotranspiration according to various, commonly used methods allows the comparison of the calculated latent heat flux values with the measured ones. It has been observed that the results obtained from the bulk aerodynamic method are in quite good agreement with the measured eddy correlation ones. The Penman method shows a trend of over-estimating potential evapotranspiration while the Bowen ratio and the Monteith-Penman methods give rather satisfactory results only for those cases where the value of the ratio of measured to calculated Bowen ratio is close to unity. The concept of the aridity index of the atmosphere and the state of its stability have also been investigated. (Author's abstract)
W89-04268

VARIATION IN EVAPOTRANSPIRATION AND CAPILLARY RISE WITH CHANGING SOIL PROFILE CHARACTERISTICS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 2G.
W89-04271

DAILY POTENTIAL EVAPOTRANSPIRATION MODELLING,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
G. Tsakiris.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 393-402, June 1988. 4 fig, 1 tab, 20 ref.

Descriptors: *Model studies, *Evapotranspiration, Stochastic models, Markov process, Wilson Hilferty transformation, Greece.

A stochastic procedure for modeling evapotranspiration consists of two steps: the sequence of four different types of day in relation to rainfall occurrence is obtained by a two-state, first-order Markov chain model; and the daily potential evapotranspiration is generated for each type of day by employing a simple autoregressive model. The Wilson-Hilferty transformation is used to incorporate asymmetry in the model. Comparing the historical and synthetic series in four meteorological stations in Greece by means of the main statistical parameters, such as the arithmetic mean, standard deviation, skewness coefficient and dimensionless maximum and minimum values, it was concluded that, for summer months, the deviations from the arithmetic mean of potential evapotranspiration are relatively low, and therefore the mean daily values may be used as reliable representations for each month in most agricultural and hydrological models. (Author's abstract)
W89-04278

2E. Streamflow and Runoff

MAINSTEM AND OVERBANK FLOW SEDIMENT MOVEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-03352

MONITORING BIRD POPULATION DENSITIES ALONG THE COLORADO RIVER IN GRAND CANYON,
Glen Canyon Environmental Studies, Flagstaff,

AZ.
For primary bibliographic entry see Field 6G.
W89-03379

BEAVER HABITAT USE AND IMPACT IN TRUCKEE RIVER BASIN, CALIFORNIA,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
P. Beier, and R. H. Barrett.
Journal of Wildlife Management JWMAA9, Vol. 51, No. 4, p 794-799, 1987. 4 tab, 16 ref.

Descriptors: *Rivers, *Beavers, *Wildlife habitats, *California, Truckee River, Regression analysis, Streams, Stream gradient, Forages, Cottonwood trees, Willow trees, Ecology, River basins.

Stepwise logistic regression was used to identify factors important for habitat use by beavers on streams. Increasing stream width and depth and decreasing gradient had the strongest positive effects on habitat use; food-availability variables added little explanatory power. Some abandoned colony sites appeared to have been located on physically-unsuitable habitat, whereas others appeared to be physically-suitable sites abandoned due to resource depletion. The fact that few unused or uncolonized reaches were misclassified as suitable habitat suggests that suitable habitat has been saturated. Impact of beaver on woody plants was assessed for 8 forage species. Local extinction of quaking aspen (Populus tremuloides) and black cottonwood (P. trichocarpa) occurred on 4-5% of stream reaches. Willow (Salix spp.) showed good vigor despite heavy use in most reaches. (Author's abstract)
W89-03429

ROLE OF STREAM SUBSTRATES IN ALUMINIUM MOBILITY AND ACID NEUTRALIZATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W89-03446

HUMMOCKING BY LOTIC CHARA: OBSERVATIONS ON ALTERATIONS OF HYPORHEIC TEMPERATURE PATTERNS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
S. P. Hendricks, and D. S. White.
Aquatic Botany AQBODS, Vol. 31, No. 1-2, P 13-22, July 1988. 5 fig, 1 tab, 34 ref.

Descriptors: *Aquatic plants, *Water temperature, *Streams, Interstitial water, Nutrients, Lotic environment, Michigan.

Stream-bed temperature profiles were used to examine hyporheic water patterns beneath Chara hummocks in a northern Michigan stream. Hummocks were found to alter expected hyporheic temperature patterns significantly, causing apparent upwellings of deeper, colder waters into the hummock. The magnitude of temperature pattern alterations was proportional to the size of the hummock, and hummocks were often situated in areas of the stream where cooler hyporheic water was closest to the stream-bed surface. Upwelling and downwelling patterns caused by hummocks conformed to the literature on hyporheic flow alterations imposed by inanimate objects on the stream-bed surface. Hyporheic water upwellings may be of benefit to Chara by exposing the anchorage system to higher nutrient or ion levels existing in interstitial water. (Author's abstract)
W89-03466

CORRELATIONS BETWEEN PHYSICO-CHEMICAL FACTORS AND POPULATION DENSITY OF CLADOCERANS IN THE TIGRIS AND DIYALA RIVERS AT BAGHDAD, IRAQ,
Scientific Research Council, Baghdad (Iraq).
H. H. Mangalo, and M. M. Akbar.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 7, p 627-643, October 1988. 9 fig, 23 ref.

Descriptors: *Physicochemical properties, *Cladocerans, *Population density, Iraq, Seasonal variation, Rivers, Flow velocity, Water temperature, Dissolved oxygen, Conductivity, Hydrologic data collections, Chlorophyll a, Population dynamics, Transparency, Daphnia.

Seasonal variation of some environmental factors such as water temperature, dissolved oxygen, hydrogen ion concentration, transparency, electrical conductivity, velocity of water flow and chlorophyll a were studied for one year in two rivers, Tigris and Diyala at Baghdad. Seasonal qualitative and quantitative studies of the cladocerans of the two rivers are reported. Eight species comprise the cladoceran fauna of Diyala River: Bosmina longirostris, Moina affinis, Ceriodaphnia cornuta, Simocephalus vetulus, Daphnia lumholtzi, Chydorus sphaericus, Macrothrix laticornis, Diaphanosoma brachyurum, whereas at Tigris River five species comprise the cladocerans fauna: B. longirostris, M. affinis, C. cornuta, S. vetulus and D. brachyurum. Population density of these cladocerans was studied in relation to some physico-chemical factors as mentioned previously and found there is a positive relationship between population density and dissolved oxygen concentration, velocity of water current, and transparency for both rivers and negative relationship with surface water temperature and chlorophyll a. (Author's abstract)
W89-03487

SECONDARY PRODUCTION AND ENERGY TRANSFER IN THE POLLUTED RIVER SAALE (THURINGIA, SOUTHERN GDR),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
For primary bibliographic entry see Field 5C.
W89-03494

REAERATION OF OXYGEN IN SHALLOW, MACROPHYTE RICH STREAMS: II. RELATIONSHIP BETWEEN THE REAERATION RATE COEFFICIENT AND HYDRAULIC PROPERTIES,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 2H.
W89-03495

SEASONAL BIOMASS AND PRODUCTIVITY OF THE SUBMERGED MACROPHYTES IN A POLLUTED WISCONSIN STREAM,
Wisconsin Univ.-Madison. Dept. of Botany.
J. D. Madsen, and M. S. Adams.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 41-50, August 1988. 5 fig, 3 tab, 40 ref.

Descriptors: *Stream pollution, *Aquatic productivity, *Biomass, *Macrophytes, Seasonal variation, Water temperature, Wisconsin.

Biomass and light/dark bottle productivity of macrophytes in a Wisconsin stream were measured throughout one growing season. Badfish Creek in southern Wisconsin receives treated sewage effluent. The stream also receives large loadings of nutrients that create high ambient concentrations of nitrogen (14 mg/L) and phosphorus (6 mg/L). Except for a brief period in early spring when a Cladophora glomerata-filamentous algal community was dominant, Potamogeton pectinatus was the dominant macrophyte species in Badfish Creek. Maximum community biomass was 710 g dry weight (DW)/sq m, with a maximum aboveground biomass of 620 g DW/sq m and a maximum belowground biomass of 120 g DW/sq m. Annual productivity was estimated at 1435 g DW/sq m/year, with a calculated P/B of 2.01. In situ net production averaged 2.83 g C/g ash-free dry weight/h. Net positive carbon gain by the P. pectinatus community occurred when water temperatures were above 15 C, and daylength at least 12 h. This is correlated to the onset of tuber germination in spring, and the point of maximal biomass decline in autumn. (Author's abstract)
W89-03498

NITROGEN CYCLING BETWEEN SEDIMENT AND THE SHALLOW-WATER COLUMN IN THE TRANSITION ZONE OF THE POTOMAC RIVER AND ESTUARY: I. NITRATE AND AMMONIUM FLUXES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2L.
W89-03504

TRACE METALS DISTRIBUTION IN HUANGHE (YELLOW RIVER) ESTUARINE SEDIMENTS,
Shandong Coll. of Oceanography (China). Dept. of Chemistry.
For primary bibliographic entry see Field 2L.
W89-03505

FLUX OF PARTICULATE INORGANIC MATTER THROUGH THE NIGER RIVER INTO THE ATLANTIC OCEAN,
Lagos Univ. Abeokuta Campus (Nigeria). Coll. of Science and Technology.
O. Martins.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 2, p 91-97, July 1988. 3 fig, 4 tab, 20 ref.

Descriptors: *Particulate matter, *Sediment discharge, *Sediment transport, *Niger River, Sediment erosion, Seasonal variation, Silicate rocks, River basins, Drainage systems.

The solid load level in the Niger River proved to be subject to distinct seasonal variations, the highest concentration being attained well before peak river discharge. A total of 25.4 billion kg of sediment was flushed into the Atlantic through the drainage system in 1980-81, representing an upward review of a previous estimate made in 1982. The specific erosion rate then becomes 20,500 kg/sq km/y, the highest so far measured in Africa. The composition of the transported sediment reflects the chemical disintegration of silicate rocks predominant in the basin. (Author's abstract)
W89-03535

FIELD OBSERVATIONS ON THE INFLUENCE OF LOW WATER VELOCITIES ON DRIFTING OF BULINUS GLOBOSUS,
Institut Tropical Suisse, Ifakara (Tanzania). Field Lab.
For primary bibliographic entry see Field 2H.
W89-03547

NUISANCE BIOMASS LEVELS OF PERIPHYTIC ALGAE IN STREAMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-03549

LIFE HISTORIES, ABUNDANCE AND DISTRIBUTION OF SOME MACROINVERTEBRATES FROM A SOUTH CAROLINA, USA COASTAL PLAIN STREAM,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-03551

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
J. Warwick, and A. R. Hill.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 231-240, January 22, 1988. 3 fig, 3 tab, 39 ref.

Descriptors: *Streams, *Groundwater movement, *Nitrates, *Denitrification, *Forest watersheds, Organic soils, Riparian land, Springs, Nitrogen removal, Acetylene reduction, Enrichment, Substrates, Cores, Ontario, Surface-groundwater relations.

Field enrichments with nitrate in two spring-fed natural drainage lines within the riparian zone of a small woodland stream near Toronto, Ontario

showed an absence of nitrate depletion. The term drainage line has been defined as a line of flow having some depth but not necessarily contained within banks formed by water erosion. Laboratory experiments with riparian substrates overlain with nitrate-enriched solutions revealed a loss of only 5-8% of the nitrate during 48 h incubation at 12 C. However, 22-24% of the initial nitrate was depleted between 24 and 48 h when a second set of substrate cores was incubated at 20 C. Short-term (3 h) incubations of fresh substrates amended with acetylene were used to estimate in-situ denitrification potentials which varied from 0.05-3.19 microg N/g/d for organic and sandy sediments. Denitrification potentials were highly correlated with initial nitrate content of substrate samples implying that low nitrate levels in groundwater and riparian substrates may be an important factor in controlling denitrification rates. The efficiency of nitrate removal in spring-fed drainage lines is also limited by short water-residence times of < 1 h within the riparian zone. These data suggest that routes of groundwater movement and substrate characteristics are important in determining nitrate depletion within stream riparian areas. (Author's abstract)
W89-03553

DEGRADATION OF SOFTWOOD (14C LIGNIN) LIGNOCELLULOSES AND ITS RELATION TO THE FORMATION OF HUMIC SUBSTANCES IN RIVER AND POND ENVIRONMENTS,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2H.
W89-03559

EFFECTS OF HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER ON THE DISTRIBUTION OF AQUATIC MACROINVERTEBRATES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5C.
W89-03571

ZOOPLANKTON ABUNDANCE AND TRANSPORT IN A TROPICAL WHITE-WATER RIVER,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W89-03582

IMPACT OF DISSOLVED AMINO ACIDS ON PROTEIN AND CELLULOSE DEGRADATION IN STREAM WATERS,
Lund Univ. (Sweden). Lab. of Ecological Chemistry.
For primary bibliographic entry see Field 2H.
W89-03587

USE OF PERIPHYTON COMMUNITIES FOR NUTRIENT REMOVAL FROM POLLUTED STREAMS,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5G.
W89-03594

RELIABILITY BASED DISCRETE DIFFERENTIAL DYNAMIC PROGRAMMING MODEL FOR RIVER WATER QUALITY MANAGEMENT UNDER FINANCIAL CONSTRAINT,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W89-03681

REDUCED RESIDENCE TIME EFFECT: IS THE LOWEST FLOW THE WORST FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-03684

MODELLING STREAM ACIDIFICATION IN UPLAND WALES,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W89-03697

SIMCAT-A CATCHMENT SIMULATION MODEL FOR PLANNING INVESTMENT FOR RIVER QUALITY,
Anglian Water Authority, Huntingdon (England).
For primary bibliographic entry see Field 6A.
W89-03700

UNCERTAINTY ANALYSIS IN WATER QUALITY MODELING USING QUAL2E,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03710

RECURSIVE RIVER WATER QUALITY ESTIMATION USING ABSTRACT EVOLUTION EQUATIONS IN FUNCTIONAL SOBOLEV SPACES,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6A.
W89-03711

KINETIC AND EQUILIBRIUM FORMULATIONS IN MODELLING OF HYDROPHOBIC ORGANIC CHEMICALS IN SURFACE AND GROUND WATERS,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03712

TWO-DIMENSIONAL SHALLOW WATER FLOW IDENTIFICATION,
Ministerie van Verkeer en Waterstaat, The Hague (Netherlands). Dienst Informatieverwerking.
For primary bibliographic entry see Field 2A.
W89-03740

APPRAISAL OF WATER RESOURCES OF THE BOULDER AND STILLWATER RIVER BASINS, INCLUDING THE STILLWATER COMPLEX, SOUTH-CENTRAL MONTANA,
Geological Survey, Billings, MT.
For primary bibliographic entry see Field 2F.
W89-03756

EVALUATION OF TECHNIQUES FOR MEASURING STREAMFLOW AND FOR ESTIMATING FLOW CHARACTERISTICS OF STREAMS IN THE MISSISSIPPI RIVER DELTA, PRAIRIES, AND COASTAL MARSHES OF LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-03757

HYDROLOGIC DATA FOR CECIL COUNTY, MARYLAND,
Maryland Geological Survey, Baltimore.
R. E. Willey, R. A. McGregor, J. DeGrouchy, and M. D. Tompkins.
Maryland Geological Survey Basic Data Report No. 16, 1987. 150p, 4 fig, 13 tab, 22 maps, 9 ref.

Descriptors: *Surface waters, *Groundwater, *Data collections, *Hydrologic data collections, *Maryland, Cecil County, Chemical analysis, Streamflow, Pesticides, Water level, Wells, Pollutant identification, Water use.

This report is a compilation of surface water and groundwater data for Cecil County, Maryland. Surface water data include streamflow measurements and chemical analyses of water for 29 partial-record stations. Analysis of stream-bottom materials also are shown for trace elements at 20 sites and for pesticides at 10 sites. Groundwater data include water level measurements for 54 wells, descriptions of 1,540 selected wells and 36 springs, chemical analysis of water from 86 wells, and lithologic logs of 17 wells and test borings ranging in depth from 95 to 1,458 feet. Surface water and groundwater appropriation data also are reported. (Author's abstract)
W89-03758

EFFECTS OF FLOOD CONTROLS PROPOSED FOR THE SUCKER RUN BASIN, CHESTER COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-03762

WATER RESOURCES OF SOUTHERN COCONINO COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-03764

WATER RESOURCES DEVELOPMENT IN LOUISIANA, 1987.
Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A189 656. Price codes: A06 in paper copy, A01 in microfiche. 1987. 130p.

Descriptors: *Water resources development, *Flood control, *Louisiana, *Mississippi River, Ouachita River, Tensas River, Red River, Pearl River, Lake Pontchartrain, Vermillion River, Mermentou River, Calcasieu River, Sabine River, Navigation.

The Mississippi River Commission (MRC) was created by an Act of Congress in 1879 to improve navigation and flood control on the Mississippi River. Levees are the backbone of the system and cover more than 2,000 miles along the Mississippi River and principal tributaries extending from ape Girardeau, Missouri, to Venice, Louisiana. Their purpose is to continue floodwaters to the main channel and designated floodways. Current information is presented on the scope and progress of water resources development by the U.S. Army Corps of Engineers and the MRC in the State of Louisiana. Also discussed is the role of the Corps in planning, constructing, and operating protects for flood control, navigation, and other beneficial uses of water resources. Projects that are completed, under way, or in the planning stage are described, with the principal activities organized by river basins. A map of each basin is located at the beginning of each section. Each of the 12 major river basins in Louisiana is discussed in its own section: Mississippi River Basin, Atchafalaya River Basin, Ouachita River Basin, Tensas River Basin, Red River Basin, Pearl River Basin, Lake Pontchartrain Basin, Mississippi River Delta Area, Vermillion River and Bayou Teche Basins, Mermentau River Basin, Calcasieu River Basin, and Sabine River Basin. (Lantz-PTT)
W89-03765

SUSPENDED-SEDIMENT CHARACTERISTICS OF THE YANTIC RIVER AT YANTIC, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-03771

HYDROLOGY OF A STREAM-AQUIFER SYSTEM IN THE CAMP VERDE AREA, YAVAPAI COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-03773

WATER RESOURCES INVESTIGATIONS IN MISSISSIPPI, 1982-83.

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-03781

CONDENSED DISAGGREGATION PROCEDURES AND CONSERVATION CORRECTIONS FOR STOCHASTIC HYDROLOGY,
URS Consultants, Sacramento, CA.
J. C. Grygier, and J. R. Stedinger.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1574-1584, October 1988. 8 fig, 5 tab, 24 ref. NSF Grant CEE-8351819.

Descriptors: *Hydrologic models, *Model studies, *Streamflow, Simulation, Disaggregation models, Model size, Seasonal variation, Model testing.

Disaggregation models are perhaps the best available method for generating multiseasonal multisite streamflow sequences for use in water resource system simulations. They are the basis of two general packages: LAST and SPIGOT. Both packages use staged disaggregation procedures and condensed disaggregation models to avoid the excessive number of parameters required by the multisite monthly Valencia-Schaake model. The model size issue and what is gained and lost by the use of condensed models were examined. In particular, when modeling the normal transforms of streamflow volumes, generated seasonal flows generally fail to sum to the specified annual total. A Monte Carlo study demonstrates that the discrepancy can be quite large and that alternative correction schemes perform quite differently. (Author's abstract)
W89-03798

NUTRIENT INFLUENCE ON A STREAM GRAZER: ORTHOCLADIUS MICROCOMMUNITIES RESPOND TO NUTRIENT INPUT,
Minnesota Univ.-Duluth. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-03820

ESTIMATING RUNOFF VOLUMES FROM FLAT, HIGH-WATER-TABLE WATERSHEDS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
J. C. Capece, K. L. Campbell, L. B. Baldwin, and K. D. Konyha.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1397-1402, September-October 1987. 5 fig, 3 tab, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Watersheds, *Storm runoff, *Mathematical analysis, Watershed management, Flatwoods, Florida.

Four methods of estimating stormwater runoff total volume are evaluated as to their performance on watersheds of Florida's flatwoods resource area. Three additional techniques representing modifications and extensions of existing methods are developed and their performance evaluated. Characteristics of flatwoods watersheds include extremely flat relief, sandy soils, dynamic shallow water tables, and scattered wetlands. Data collected by the U.S. Geological Survey (USGS) and South Florida Water Management District (SFWMD) from 5 small (8-1450) ha) agricultural watersheds (improved and unimproved pasture) served as the basis of evaluation. All total volume estimation techniques examined rely upon the SCS (Soil Conservation Service) runoff equation. Best results were achieved with methods which included antecedent depth to the water table as a measure of watershed storage potential. (Author's abstract)
W89-03833

ECOLOGY OF A FREE-FLOWING RIVER OF THE SOUTHERN ALPS: THE BUCH (FRANCE): II. ACTION OF A POLLUTING FLUX ON THE WATER'S HYDROCHEMISTRY (ECOLOGIE D'UNE RIVIERE NON AMENAGEE DES ALPES DU SUD: LE BUECH (FRANCE): II. ACTION D'UN FLUX POLLUTANT SUR L'HYDROCHIMIE DU COURS D'EAU),
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5C.
W89-03842

MACROBENTHOS OF THE SAONE RIVER (LE MACROBENTHOS DE LA SAONE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
For primary bibliographic entry see Field 2H.
W89-03846

INFLUENCE OF THE WATER POLLUTION ON THE STRUCTURE AND DYNAMICS OF BENTHOS IN THE STREAM VYDRICA (SMALL CARPATHIANS),
Komenskeho Univ., Bratislava (Czechoslovakia). Zoological Inst.
For primary bibliographic entry see Field 5C.
W89-03847

REACTION OF BLACKFLY LARVAE (DIPTERA, SIMULIIDAE) TO PAPER-MILL WASTE WATERS,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
For primary bibliographic entry see Field 5C.
W89-03848

RESPONSE OF YOUNG-OF-THE-YEAR CUTTHROAT TROUT TO MANIPULATION OF HABITAT STRUCTURE IN A SMALL STREAM,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W89-03849

VARIATIONS IN ABUNDANCE OF YOUNG-OF-THE-YEAR CHANNEL CATFISH IN A NAVIGATION POOL OF THE UPPER MISSISSIPPI RIVER,
National Fisheries Research Center, La Crosse, WI.
For primary bibliographic entry see Field 2H.
W89-03850

SEASONAL AND SPATIAL VARIATIONS IN BENTHIC MACROINVERTEBRATE COMMUNITIES OF MAGELA CREEK, NORTHERN TERRITORY,
Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia).
For primary bibliographic entry see Field 2H.
W89-03855

WATER QUALITY VARIATIONS DURING A FLOOD EVENT IN THE ANNAN RIVER, NORTH QUEENSLAND,
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
For primary bibliographic entry see Field 5B.
W89-03856

FISH DENSITY VARIATIONS IN THE BRAIDED ASHLEY RIVER, CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Christchurch (New Zealand). Freshwater Fisheries Centre.
For primary bibliographic entry see Field 2H.
W89-03858

COMPARATIVE STREAM RESIDENCE OF JUVENILE BROWN AND RAINBOW TROUT IN A SMALL LAKE TRIBUTARY, SCOTTS CREEK, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-03863

PERIPHYTON SAMPLER FOR SHALLOW, SWIFT RIVERS,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 7B.
W89-03864

LITHIUM AND RUBIDIUM IN THE WAIKATO RIVER, NEW ZEALAND,
Spectrum Resources Ltd., Auckland (New Zealand).
For primary bibliographic entry see Field 2K.
W89-03865

RECOVERY OF BENTHIC MACROINVERTEBRATE AND EPILITHIC COMMUNITIES FOLLOWING A LARGE FLOOD, IN AN UNSTABLE, BRAIDED, NEW ZEALAND RIVER,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-03871

CARBON MOVEMENT IN RUNOFF AND EROSION UNDER SIMULATED RAINFALL CONDITIONS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. Lowrance, and R. G. Williams.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1445-1448, September-October 1988. 3 fig, 3 tab, 13 ref.

Descriptors: *Soil organic matter, *Organic carbon, *Erosion, *Surface Runoff, *Soil-water-plant relationships, *Agricultural runoff, *Soil erosion, *Vegetation effects, Leaching, Peanuts, Simulated rainfall, Sediments.

Organic carbon loss in erosion contributes to depletion of soil organic matter in continuously cultivated soils. Runoff, erosion, and C movement were measured from eight 39.6 sq m plots under simulated rainfall in order to assess C movement from a coastal plain soil. Plots were located at the University of Georgia Coastal Plain Experimental Station near Tifton, Georgia, on a Tifton loamy sand (fine-loamy, siliceous, thermic Plinthic Paleudults). Four soil cover conditions were duplicated on the eight plots: two-row peanuts (Arachis hypogea L.), four-row peanuts, continuous fallow, and bare-bedded. Samples were taken during rainfall simulator events in March, July, and September 1985 and April 1986. Continuous fallow plots had significantly higher C concentrations in runoff and higher sediment concentrations. Sediment from the four-row peanut plots had the highest C content, 5.83%. Total loads of C and sediment and total runoff were about twice as high from the bare-bedded plots. Approximately 1.0% of the total soil C could be moved annually from the continuous fallow plots with a lower percentage from the other treatments. Runoff as well as sediment and C loads were lowest for simulated rainfall during September when peanuts had been inverted and were on the soil surface. Events in March and April produced lower runoff and lower sediment and C loads than events in July. Apparently the residue cover in the spring was more effective at preventing runoff and erosion than the partial crop canopy in July. (Author's abstract)
W89-03903

RECONSTRUCTION OF PAST RIVER FLOW AND PRECIPITATION IN CANTERBURY, NEW ZEALAND FROM ANALYSIS OF TREE-RINGS,
Canterbury Univ., Christchurch (New Zealand). School of Forestry.
D. A. Norton.
Journal of Hydrology JHYDA7, Vol. 26, No. 2, p 161-174, 1987. 4 fig, 5 tab, 37 ref.

Descriptors: *Dendrochronology, *Paleohydrology, *Streamflow forecasting, *River flow, *Precipitation, *Trees, *New Zealand, Climatology, Statistical analysis, Regression analysis, Meteoro-

logical data collection, Seasonal variation, Beech trees, Flow measurement, River.

Nothofagus solandri tree-ring chronologies developed from four mid-altitude sites in Canterbury, New Zealand are statistically similar but distinct from subalpine N. Solandri chronologies in the same area. Ring-width is strongly influenced by summer precipitation, with less growth in summers of below average precipitation. Reconstructions from 1879 A.D. of Lake Coleridge summer precipitation and Hurunui River summer flow records from tree-rings are presented. The flow reconstruction suggests that the frequency of low river flow summers between 1879 and 1977 was three times greater than over the period of measured river flow (1956-1977). These reconstructions illustrate the potential of dendroclimatology to provide long-term proxy hydrological data for the management of water. (Author's abstract)
W89-03966

VARIATION OF WATER YIELD FROM CATCHMENTS UNDER INTRODUCED PASTURE GRASS AND EXOTIC FOREST, EAST OTAGO,
Ministry of Works and Development, Dunedin (New Zealand).
For primary bibliographic entry see Field 4C.
W89-03967

HYDROLOGY AND LONG-TERM GEOMORPHIC SIGNIFICANCE OF A FLASH FLOOD IN THE CAIRNGORM MOUNTAINS, SCOTLAND,
College of St. Paul and St. Mary, Cheltenham (England). Dept. of Geography and Geology.
L. J. McEwen, and A. Werritty.
Catena, Vol. 15, No. 3-4, p 361-377, June-August 1988. 6 fig, 2 tab, 35 ref.

Descriptors: *Floods, *Hydrology, *Scotland, *Geomorphology, *Flash floods, Slopes, Rainfall impact, Hydraulics, Channels, Sedimentation, Channel morphology, Erosion.

The geomorphic impact and long term geomorphic significance, in terms of slope and valley-floor development, of the flood that occurred on August 4, 1978 in Scotland, on the Allt Mor are assessed. The hydrometeorological characteristics of the flood are reconstructed and placed in the context of the catchment's flood history. In magnitude-frequency terms, the dominant geomorphic processes in this environment are floods which occur several times a century. The specific response of the Allt Mor to such floods varies spatially across the catchment; the major impact being recorded in the entrenched and channel reaches. Also significant are the sequence and inter-arrival times of floods of differing magnitudes, the high thresholds for channel and slope adjustment, and the nature of the coupling between slope and channel systems. The results confirm and strengthen the findings reported from other sites in upland Britain. (Author's abstract)
W89-03975

CONFINEMENT AND BED-FRICTION EFFECTS IN SHALLOW TURBULENT MIXING LAYERS,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-03981

HYDRAULIC RESISTANCE OF RIPPLES,
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
For primary bibliographic entry see Field 8B.
W89-03982

STREAMFLOW AND WATER QUALITY DATA FOR THREE MAJOR TRIBUTARIES TO REELFOOT LAKE, WEST TENNESSEE, OCTOBER 1987-MARCH 1988,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04035

HYDROLOGIC AND SUSPENDED-SEDIMENT DATA FOR REELFOOT LAKE, OBION AND LAKE COUNTIES, NORTHWESTERN TENNESSEE, MAY 1985-SEPTEMBER 1986,
Geological Survey, Nashville, TN. Water Resources Div.
J. W. Garrett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-170, August 1988, 50p, 30 fig, 13 tab, 4 ref.

Descriptors: *Suspended sediment, *Streamflow, *Reelfoot Lake, *Tennessee, *Hydrologic data, Data collections, Rainfall, Groundwater.

Hydrologic data for Reelfoot Lake in Obion and Lake Counties, Tennessee, were collected at 4 surface water inflow stations, 1 outflow station, 2 rainfall stations, 2 lake elevation stations, and 29 wells for the period May 1, 1985 through September 30, 1986. Additionally, suspended-sediment data were collected at three stations on two of the major tributaries to the lake. (USGS)
W89-04039

STATION DESCRIPTIONS AND AVAILABILITY OF DISCHARGE AND WATER QUALITY DATA THROUGH 1985 FOR EASTERN MONTANA STREAM SITES NOT INCLUDED IN THE NATIONAL WATER DATA EXCHANGE PROGRAM,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04042

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN ILLINOIS, 1987,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04044

SUMMARY OF WATER RESOURCES DATA FOR THE GIRDWOOD-ALYESKA AREA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04046

FLOOD OF APRIL 1987 IN MAINE, MASSACHUSETTS, AND NEW HAMPSHIRE.
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-460, 1987. 35p, 9 fig, 3 tab, 11 ref.

Descriptors: *Floods, *Maine, *Massachusetts, *New Hampshire, Streamflow, Precipitation, Snowmelt.

Widespread flooding ocurred through a large part of New England in early to mid-April 1987. The States affected most by these floods were Maine, Massachusetts, and New Hampshire. The flooding was the result of two distinct storms-one that brought heavy rains to the area from March 30 to April 2 and the other that brought additional precipitation from April 4 through April 8. Fortunately for the residents of Maine, Massachusetts, and New Hampshire, the two storms developed their greatest intensity and dropped the most precipitation over different parts of the three-State area. The first storm combined with meltwater from the snowpack to produce major flooding primarily in the western and south-central parts of Maine. The second storm produced flooding primarily in southern New Hampshire and northeastern and northwestern Massachusetts. Many streams in the affected area produced peaks that exceeded previously known flood heights and discharges, and the recurrence interval of many peak discharges exceeded 100 years. (USGS)
W89-04050

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1986 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, T. E. Lamb, and S. P. Blumer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-203, 1987. 38p, 1 fig, 3 tab, 3 ref.

Descriptors: *Annual yield, *Hydrologic data, *Arkansas River Compact, *Interstate compacts, *Water yield, *Reservoir storage, Stream discharge, Water quality, Arkansas, Oklahoma.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly, maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. Water quality data are shown for four sites in the compact area. (USGS)
W89-04058

FLOODS IN EASTERN NEBRASKA AND SOUTHEASTERN SOUTH DAKOTA, JUNE 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
G. B. Engel, and R. D. Benson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-215, 1987. 31p, 15 fig, 3 tab, 8 ref.

Descriptors: *Nebraska, *South Dakota, *Floods, *Flood peak, Flood flows, Precipitation, Rainfall-runoff relationships.

Thunderstorms during 1984 produced significant rainfall and subsequent runoff that caused substantial flooding in eastern Nebraska and southeastern South Dakota. The storms ocurred in rapid succession over the area, and the rain fell on ground that was near saturation from greater-than-normal precipitation during April and May. Flooding ocurred in the Loup River, Blue River, Platte River, Elkhorn River, and Weeping Water Creek basins in Nebraska and the James River, Vermillion River, and Big Sioux river basins in South Dakota. Record and near-record peak discharges occurred on many streams. The floodflows from tributary streams caused the highest stages and the most widespread flooding along the Missouri River from Sioux City, Iowa, to Rulo, Nebraska, since April 1952. (USGS)
W89-04059

INTRODUCTION TO RAPIDLY-VARIED UNSTEADY, FREE-SURFACE FLOW COMPUTATION,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 8B.
W89-04073

RECONNAISSANCE OF SURFACE-WATER RESOURCES IN THE KOBUK RIVER BASIN, ALASKA, 1979-80,
Geological Survey, Anchorage, AK. Water Resources Div.
J. M. Childers, and D. R. Kernodle.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 83-4027, 1983. 35p, 14 fig, 10 tab, 12 ref.

Descriptors: *Water resources, *Data collections, *Water resources data, *Alaska, *Hydrologic data, Surface waters, Floods, Discharge.

Surface water data were collected at selected sites in the Kobuk River Basin in northwest Alaska in August 1979 and April 1980. In August 1979, frequent heavy rains caused abnormally high flows in the basin; unit runoff values, computed from discharge measurements at 25 sites, ranged from 0.08 to 12.2 cu ft/sec/sq mi. Mean unit runoff for August computed from 13 years of record at a stream gaging station on the Kobuk River ranged from 1 to 3 cu ft/sec/sq mi. Unit runoff computed from discharge measurements made at eight sites in April 1980 ranged from 0 to 0.30 cubic feet per second per square mile. These values are in reasonable agreement with those derived from the record at the gaging station. High-water marks of maximum evident floods and evidence of ice-affected flooding were found at near bankfull stages at 17 sites on the Kobuk River and its tributaries. Computed unit runoff for the maximum evident floods generally decreases with increasing drainage area. Unit runoff ranges from about 50 to 75 cu ft/sec/sq mi for drainage areas < 1,000 sq mi to < 25 cu ft/sec/sq mi for larger areas. Field determinations were made of water temperature, pH, alkalinity, dissolved-oxygen concentration, and specific conductance, and discharge was measured at about 40 stream sites and one spring. Water samples for laboratory analysis of dissolved inorganic constituents and biological samples were collected in August 1979. Water quality data indicate that the surface waters would be acceptable for most uses; they are a calcium bicarbonate type having dissolved-solids concentrations between 50 and 140 milligm/liter. The pristine nature of the waters is also indicated by the overall diversity and composition of its benthic invertebrate community. A more highly mineralized (about 550 milligm/liter dissolved solids) sodium bicarbonate water flows from Reed River Hot Spring. (USGS)
W89-04083

SIMULATION OF RAIN FLOODS ON WILLOW CREEK, VALLEY COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4341, 1986. 89p, 21 fig, 3 tab, 11 ref.

Descriptors: *Flood peak, *Streamflow, *Rainfall-runoff relationships, *Flood forecasting, Simulation analysis, Hydrologic models, Montana, Reservoirs.

The Hydrologic Engineering Center-1 rainfall-runoff simulation model was used to assess the effects of a system of reservoirs and waterspreaders in the 550-sq mi Willow Creek Basin in northeastern Montana. For simulation purposes, the basin was subdivided into 100 subbasins containing 84 reservoirs and 14 waterspreaders. Precipitation input to the model was a 24-hr duration, 100-yr frequency synthetic rainstorm developed from National Weather Service data. Infiltration and detention losses were computed using the U.S. Soil Conservation Service Curve Number concept, and the dimensionless unit hydrograph developed by the U.S. Soil Conservation Service was used to compute runoff. Channel and reservoir flow routing was based on the modified Puls storage routing procedure. Waterspreaders were simulated by assuming that each dike in a spreader system functions as a reservoir, with only an emergency spillway discharging directly into the next dike. Waterspreader and reservoir volumes were calculated from surface areas measured on maps. The first simulation run was made with no structures in place, and resulted in a 100-yr frequency peak at the mouth of Willow Creek of 22,700 cu ft/sec. With all structures in place, the 100-yr frequency peak was decreased by 74% to 5,870 cu ft/sec. (USGS)
W89-04090

DETERMINING STREAMFLOW CHARACTERISTICS BASED ON CHANNEL CROSS-SECTION PROPERTIES-STATE OF THE ART,
Geological Survey, Lakewood, CO. Water Resources Div.
K. L. Wahl.
Available from Supt. of Docs, GPO, Washington, D. C. 20402. In: USGS Water Supply Paper 2262, 1984. p 53-66, 5 fig, 4 tab, 53 ref.

Descriptors: *Regional analysis, *Flood flow, *Streamflow, *Channel morphology, *Hydraulic geometry, *Streamflow characteristics, *Stream gaging, North America, United States, Western United States.

Channel dimensions have proven to be valid indicators of streamflow characteristics. Use of channel geometry requires that a relation be defined between the desired flow characteristic and stream channel size based on data at gaging stations; estimates of the flow characteristic can then be made at ungaged sites by obtaining measurements of the channel dimensions. Regional analyses have been made in many Western States and in some Eastern States by the U.S. Geological Survey. These analyses are summarized and some results are compared. Three reference levels have been used to define the channel dimensions. The principal differences between the channel geometry approach and conventional approaches using basin characteristics are: (1) The ungaged site must be visited to measure the channel size before an estimate can be made; and (2) Some field training is required before an individual can identify the channel reference level. Variability between channel measurements by trained individuals effectively increases the error of estimates over the standard error of estimate defined during calibration. The amount is dependent on the variability in channel type, but extremely variable conditions could increase a calibration error of 42% to an application error of 55%. (USGS)
W89-04103

RECONNAISSANCE WATER QUALITY APPRAISAL OF THE FOUNTAIN CREEK ALLUVIAL AQUIFER BETWEEN COLORADO SPRINGS AND PUEBLO, COLORADO, INCLUDING TRACE ELEMENTS AND ORGANIC CONSTITUENTS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04104

HYDROLOGIC RECONNAISSANCE OF THE CHILKAT RIVER BASIN, SOUTHEAST ALASKA (WITH SPECIAL REFERENCE TO THE ALASKA CHILKAT BALD EAGLE PRESERVE),
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-04116

STREAMFLOW CHARACTERISTICS OF THE GREEN, BEAR, AND SNAKE RIVER BASINS, WYOMING, THROUGH 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4022, August 1988. 223p, 1 fig, 8 ref.

Descriptors: *Streamflow, *Green River Basin, *Bear River Basin, *Snake River Basin, *Wyoming, Flood frequency, Flow duration, Low flow, High flow, Average flow.

A summary of streamflow characteristics as of 1984 is presented for the Green, Bear, and Snake River Basins in Wyoming and adjacent areas, based on data from 101 streamflow-gaging stations. Streamflow characteristics include mean monthly and mean annual streamflow, duration of daily mean flow, and magnitude and probability of instantaneous peak flow, annual high flow, and annual low flow. Recurrence intervals of 2, 5, 10, 25, 50 and 100 yr are utilized for the peak-flow, high-flow and low-flow characteristics. Low-flow and high-flow characteristics are also listed for standard periods of consecutive days. A station description, tables of streamflow characteristics, and graphs of mean monthly streamflow and duration of daily mean streamflow are presented for each station. Streamflow characteristics before and after dam construction are presented for five stations. (USGS)
W89-04118

FLOODS OF OCTOBER 1986 IN SOUTH-CENTRAL ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. D. Lamke, and B. B. Bigelow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-391, 1987. 31p, 11 fig, 5 tab, 7 ref.

Descriptors: *Floods, *Flood peaks, *Alaska, Precipitation, Rainfall-runoff relationships, Storm runoff.

Heavy precipitation associated with a large storm system resulted in major flooding in several areas of south-central Alaska during October 10-12, 1986. Flooding was particularly severe in the Seward area of the Kenai Peninsula and in tributaries to Susitna River from Telkeetna downstream. Flood damage has been estimated at $20 million and the region was declared a Federal disaster area. The report includes a brief discussion of meteorological conditions that caused the unusual amounts of precipitation, a summary of flood stages and discharges, a comparison to prior floods, flood-frequency estimates, a brief description of flood areas, and hydrologic data for each area. (USGS)
W89-04122

SUMMARY OF WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN COLORADO, FY 1987,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04124

HYDROLOGY OF THE LOWER LITTLE RED RIVER, ARKANSAS, AND A PROCEDURE FOR ESTIMATING AVAILABLE STREAMFLOW,
Geological Survey, Little Rock, AR. Water Resources Div.
G. D. Grosz, J. E. Terry, and A. P. Hall.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4008. July 1988. 22p, 12 fig, 3 ref.

Descriptors: *Streamflow forecasting, *Streamflow, *Surface-groundwater relations, Water allocation, Diversion, Irrigation, Groundwater, Arkansas, Little Red River, White County, Water resources data, Computer programs.

The U.S. Geological Survey, in cooperation with the Arkansas Soil and Water Conservation Commission, conducted a hydrologic investigation of the lower Little Red River from near Searcy, Arkansas (mi 31.7), to the river's mouth at its confluence with the White River. During 1983 and 1984, data were collected on streamflow, stream altitude, groundwater altitude and diversion pumping from the Little Red River. Flow in the Little Red River near Searcy is computed by using a modified stage/fall/discharge relation and stage data collected at Searcy and at Judsonia 6.5 mi downstream. This procedure uses a family of 12 rating curves that can be selected by stage records at Searcy and fall records between Searcy and Judsonia. A comparison of water levels in the river to water levels in selected alluvial wells near the river indicates that the Little Red is a gaining stream during summer and fall low periods and is a

losing stream during periods of high flow. Flows in the lower Little Red River are also significantly affected by releases from Greers Ferry Reservoir at mi 78.8 and by varying backwater conditions resulting from high stages on the White River. To meet the expressed needs of the Arkansas Soil and Water Conservation Commission, a mass balance procedure was developed to be used for estimating the amount of streamflow available along a reach of stream, given a minimum instream flow requirement set by the regulating authority. This procedure was coded into a computer program that can be invoked interactively as an aid in making streamflow allocation decisions and in maintaining related data bases. (USGS)
W89-04125

RAINFALL-RUNOFF DATA FOR SOMERSET COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04130

FLOODS IN IOWA: STAGE AND DISCHARGE,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04131

ANNUAL PEAK DISCHARGES AND STAGES THROUGH 1984 FOR GAGING STATIONS IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04145

STREAMFLOW AND CROSS-SECTION DATA FOR TOMBIGBEE RIVER BETWEEN GAINESVILLE AND DEMOPOLIS LOCKS AND DAMS,
Geological Survey, Montgomery, AL. Water Resources Div.
W. L. Psinakis, and R. A. Gardner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-202, 1987. 27p, 13 fig, 5 tab, 11 ref.

Descriptors: *Alabama, *Tennessee-Tombigbee Waterway, *Channel morphology, *Flood profiles, *Sedimentation, *Cross-sections, Streamflow, Discharge, Tombigbee River, Floods, Canals, Demopolis Lock and Dam, Gainesville Lock and Dam, Stage-discharge relations, Limit curves, Velocity-discharge relations, Flow durations.

A review of records and historical research of floods indicate that the flood of April 15-18, 1979, was the highest recorded this century along the reach of the Tombigbee River that is now bounded upstream by Gainesville Lock and Dam and downstream by Demopolis Lock and Dam. The peak discharge during this flood ranged from 247,000 cu ft/sec at Epes to 343,000 cu ft/sec at Demopolis Lock and Dam. Limit curves developed for the tailwater of Gainesville Dam, based on 105 computed discharges for four flood events since April 1979, show the range in stage for a given discharge at this site. Data from hydrographic surveys that were made for more than 100 sedimentation ranges in 1971 are on file with the U.S. Army Corps of Engineers. Presently 42 sedimentation ranges between Gainesville Lock and Dam and Demopolis Lock and Dam are surveyed routinely. Comparison of these and other data can be made in order to observe what changes have occurred along this reach of the river, as a result of natural and man-made causes. These and other hydrologic data collected along the reach of the Tombigbee River between Gainesville Lock and Dam and Demopolis Lock and Dam are presented in tables. (USGS)
W89-04146

AVAILABILITY OF STREAMFLOW DATA FOR THE MOBILE RIVER AND ITS DISTRIBUTARIES INCLUDING THE LOWER ALABAMA RIVER AND LOWER TOMBIGBEE RIVER,
Geological Survey, Montgomery, AL. Water Resources Div.
W. L. Psinakis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-201, 1987. 49p, 6 fig, 16 tab, 4 ref.

Descriptors: *Estuaries, *Distributaries, *Alabama, *Hydrologic data, *Mobile Estuary, Stage data, Discharge data, Velocity data, Water quality data, Mobile County, Baldwin County, Mobile Bay, Alabama River, Tombigbee River.

The U.S. Army Corps of Engineers and the U.S. Geological Survey have collected streamflow data from gaging stations located in and near the Mobile Estuary in southwestern Alabama since 1940. These data include stage, stream velocity, and water quality information, which were collected from 12 gaging stations and at miscellaneous sites in the region. During the period from 1978 to 1983, over 100 discharge measurements were made along the U.S. Highway 90 Causeway for the Tensaw, Apalachee, and Blakely Rivers. The purpose of this report is to publish information on the type of data collected in the region, list of availability of the data, and publish where the data can be found. (USGS)
W89-04147

STREAMFLOW AND CROSS-SECTION DATA FOR TOMBIGBEE RIVER BETWEEN ALICEVILLE AND GAINESVILLE LOCKS AND DAMS,
Geological Survey, Montgomery, AL. Water Resources Div.
W. L. Psinakis, and R. A. Gardner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-125, 1987. 27p, 14 fig, 5 tab, 13 ref.

Descriptors: *Tombigbee River, *Floods, *Flood profiles, *Alabama, *Tennessee-Tombigbee Waterway, *Channel morphology, *Sedimentation, *Canals, *Cross-sections, Aliceville Lock and Dam, Gainesville Lock and Dam, Stage-discharge relations, Velocity-discharge relations, Flow duration, Streamflow, Discharge.

A review of records and historical research of floods for the Tombigbee River near Cochrane, Alabama, show that the flood of 1892 was the highest since 1818. In 1962 the U.S. Army Corps of Engineers estimated a peak discharge of 235,000 cu ft/sec for this flood. This estimated discharge is more than 40% > the next highest flood peak; that of 1973. Limit curves developed for the tailwater of Aliceville Lock and Dam, based on 61 computed discharge and 24 discharge measurements, show the range in stage for a given discharge at this site. Similarly, limit curves developed for Gainesville Lock and Dam pool were developed based on 49 computed discharges and 10 mean daily discharges. Data from hydrographic surveys that were made for more than 100 ranges in 1937 and 1971 are on file with the U.S. Army Corps of Engineers. Presently 49 sedimentation ranges between Aliceville Lock and Dam and Gainesville Lock and Dam are surveyed routinely. Comparison of these and other data may be made to identify changes occurring along this reach of the river as a result of natural and man-made causes. These and other hydrologic data collected along the reach of the Tombigbee River between Aliceville Lock and Dam and Gainesville Lock and Dam are presented in tables. (USGS)
W89-04148

WATER RESOURCES ACTIVITIES IN ILLINOIS, 1986,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04149

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY MID-ATLANTIC DISTRICT 1984-1986,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04155

HYDROLOGIC DATA FOR SELECTED STREAMS IN THE COAL AREA OF SOUTHEASTERN OKLAHOMA, JULY 1978 TO SEPTEMBER 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04158

STREAMFLOW CHARACTERISTICS OF THE COLORADO RIVER BASIN IN UTAH THROUGH SEPTEMBER 1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. C. Christensen, E. B. Johnson, and G. G. Plantz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-421, 1987. 674p, 4 fig, 2 tab, 8 ref.

Descriptors: *Flood characteristics, *Streamflow, *Colorado River Basin, *Utah, *Hydrological data, Average discharge, Flow duration, Discharge frequency, Peak discharge, Low flow, Regulated flow, Data collections.

This report summarizes streamflow characteristics developed from records of discharge collected through September 1981 in the Colorado River Basin in Utah and in adjacent areas in Arizona, Colorado, and Wyoming are summarized. The data were compiled for 351 gaging stations for use by the U.S. Bureau of Land Management to evaluate mining impacts on the hydrologic system and by other agencies and individuals concerned with the availability of water and other water problems in the area. For each station, a description of the station location and the discharge record is given, followed by a tabulation of summaries including annual lowest and highest mean discharges for 10 sets of consecutive-day periods duration of daily discharges that illustrates the distribution of discharge during each water year and for the period of record, monthly mean discharges for each water year, annual peak discharge, and magnitude and probability of the annual lowest and highest mean discharge. Records for 16 stations are summarized in two separate periods owing to regulated streamflow by reservoirs or diversions for irrigation, municipal, and industrial use. The period before regulation and the period after regulation began are presented for comparison. (USGS)
W89-04160

HYDROLOGY OF AREA 50, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, WYOMING AND MONTANA,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04163

POTENTIAL FLOOD AND DEBRIS HAZARDS AT KATHERINE LANDING AND TELEPHONE COVE, LAKE MEAD NATIONAL RECREATION AREA, MOHAVE COUNTY, ARIZONA,
Geological Survey, Carson City, NV. Water Resources Div.
O. Mossburner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4081, 1988. 19p, 7 fig, 1 tab, 7 ref.

Descriptors: *Arizona, *Floods, *Flood frequency, *Hazards, *Flood peak, Regression analysis, Statistics.

Katherine Landing is a recreation site on the east shore of Lake Mohave, an impoundment on the Colorado River southeast of Las Vegas, Nevada.

With proper inspection and maintenance, the present (1979) channel and diking system at Katherine Landing is judged adequate to confine and restrain floods up to and including the 100-yr flood. In contrast, the 500-yr flood probably would not be confined by some parts of the diking system. The Telephone Cove area, traversed by North and South Telephone Cove Washes, is hazardous for all floods, especially for the 100-yr and more severe floods. Determinations of peak discharge are based on streamflow regression analyses, and channel capacities are based on field surveys of channel-flow capacities. The extreme flood - a flood meteorologically and hydrologically possible but so rare as to preclude a frequency estimate - could cause great damage and possible loss of life at both the Katherine Landing and the Telephone Cove sites. The present dikes would be topped or breached by extreme flooding. (USGS)
W89-04165

FLOOD-CARRYING CAPACITIES AND CHANGES IN CHANNELS OF THE LOWER PUYALLUP, WHITE, AND CARBON RIVERS IN WESTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W89-04166

U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN WEST-CENTRAL FLORIDA WITH A SECTION ON HISTORY OF THE STREAM GAGING PROGRAM IN FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
R. T. Mycyk, and R. C. Heath.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4032, 1988. 19p, 3 fig, 3 tab, 34 ref.

Descriptors: *Data collections, *Florida, *Gaging stations, *Hydrologic data, Drainage area, Average flow, History, Streamflow, Water districts, Water quality.

The results of a study of the network of the stream-gaging program in west-central Florida are documented. Selected hydrologic data, including drainage area, period of record, and mean annual flow were compiled for the 57 continuous-record gaging stations which were active in 1985. Additionally, selected hydrologic data for 20 discontinued gaging stations are included. Data uses and funding sources were identified for the stations currently being operated in west-central Florida with a budget of $320,000. All stations have been identified as having valid and needed uses, all stations are properly funded, and no short-term project stations exist within the stream-gaging program. On the basis of the analysis, it was concluded that all stations in the present stream-gaging program should be continued in operation. Future studies also will be required because of changes in demands for streamflow information with subsequent addition and deletion of gaging stations. (USGS)
W89-04167

ESTIMATING FLOOD HYDROGRAPHS AND VOLUMES FOR ALABAMA STREAMS,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
D. A. Olin, and J. B. Atkins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4041, 1988. 25p, 4 fig, 8 tab, 9 ref.

Descriptors: *Hydrograph analysis, *Design floods, *Flood hydrographs, *Alabama, Regression analysis, Computer programs.

The hydraulic design of highway drainage structures involves an evaluation of the effect of the proposed highway structures on lives, property, and stream stability. Flood hydrographs and associated flood volumes are useful tools in evaluating these effects. For design purposes, the Alabama Highway Department needs information on flood hydrographs and volumes associated with flood peaks of specific recurrence intervals (design floods) at proposed or existing bridge crossings. This report will provide the engineer with a method to estimate flood hydrographs, volumes, and lagtimes for rural and urban streams in Alabama with drainage areas less than 500 sq mi. Existing computer programs and methods to estimate flood hydrographs and volumes for ungaged streams have been developed in Georgia. These computer programs and methods were applied to streams in Alabama. The report gives detailed instructions on how to estimate flood hydrographs for ungaged rural or urban streams in Alabama with drainage areas less than 500 sq mi, without significant in-channel storage or regulations. (USGS)
W89-04168

CHANNEL INFILTRATION ALONG THE PAWNEE RIVER AND ITS TRIBUTARIES, WEST CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
J. B. Gillespie, and C. A. Perry.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $5.25, microfiche $4.00. USGS Water Resources Investigations Report 88-4055, 1988. 30p, 33 fig, 1 tab, 5 ref.

Descriptors: *Alluvial channels, *Infiltration rates, *Kansas, *Surface-groundwater relations, Ephemeral channels, Pawnee River, Flood control, Infiltrometers.

Most of the streams is west-central Kansas are ephemeral. Natural recharge to the alluvial aquifers underlying these streams occurs during periods of storm runoff in the ephemeral channels. Proposed flood-retarding structures within the basin will alter the downstream runoff characteristics in these channels by reducing the peak flow and increasing the flow duration. Information concerning channel-infiltration rate, unsaturated and saturated flow, and lithology of the unsaturated zone as related to stream stage and duration was collected along the Pawnee River and its tributaries to determine the effects of the flood-retarding structures. The infiltration rate on ephemeral streams was determined at five sites within the Pawnee River Basin. Tests were conducted in channel infiltrometers constructed by isolating a section of channel with two plastic-lined wooden cofferdams. At two of the sites, perched groundwater mounds intersected the bottom of the channel and reduced the infiltration rate. At two other sites where the perched groundwater mounds did not reach the bottom of the channel, the infiltration rate was directly proportional to the stage. Comparison of infiltration from simulated controlled and uncontrolled floodflows at the five sites indicated an average increase of about 2% with the controlled floodflow. Cumulative infiltration for these simulations ranged from 0.5 to 14.8 acre-ft/mi of channel. (USGS)
W89-04169

STREAMFLOW CHARACTERISTICS OF THE MISSOURI RIVER BASIN, WYOMING, THROUGH 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $67.25, microfiche $4.75. USGS Water Resources Investigations Report 87-4018, 1988. 431p, 1 fig, 7 ref.

Descriptors: *Flood frequency, *Flow duration, *Wyoming, *Missouri River, Low flow, High flow, Average flow, Streamflow.

Streamflow characteristics as of 1984 for the Missouri River Basin, Wyoming, based on data from 204 streamflow-gaging stations are summarized. The streamflow characteristics reported include mean monthly and mean annual streamflow; duration of daily mean flow; and magnitude and probability of instantaneous peak flow, annual low flow, and annual high flow. Recurrence intervals of 2, 5, 10, 20, or 50, and 100 yr are determined for the peak-flow, low-flow, and high-flow characteristics. Annual low-flow and high-flow characteristics are also listed for various numbers of consecutive days. A station description, tables of streamflow characteristics, and graphs of mean monthly streamflow and duration of daily mean streamflow are presented for each station. Streamflow characteristics for periods before and after dam construction or transbasin diversion are presented for six stations. (USGS)
W89-04170

REGIONAL GROUNDWATER DISCHARGE TO LARGE STREAMS IN THE UPPER COASTAL PLAIN OF SOUTH CAROLINA AND PARTS OF NORTH CAROLINA AND GEORGIA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04173

FLOW-PROPORTIONAL WATER SAMPLER FOR USE IN CONJUNCTION WITH A V-NOTCH WEIR IN SMALL CATCHMENT STUDIES,
Welsh Plant Breeding Station, Aberystwyth.
For primary bibliographic entry see Field 7B.
W89-04211

STOCHASTIC MODELLING OF RUNOFF FROM AN AGRICULTURAL WATERSHED IN SOUTHERN SASKATCHEWAN,
Agriculture Canada, Swift Current (Saskatchewan). Research Station.
S. N. Sharma, B. McConkey, and H. Steppuhn.
Canadian Agricultural Engineering CAEOAI, Vol. 30, No. 2, p 203-208, July 1988. 2 fig, 7 tab, 13 ref.

Descriptors: *Saskatchewan, *Agricultural watersheds, *Runoff, *Snowmelt, *Stochastic models, *Model studies, Hydrologic models, Time series analysis, Climatology, Simulation, Stochastic process, Topography.

Analyses of hydrologic information collected from a small agricultural watershed near Swift Current in southern Saskatchewan for the past 35 years revealed marked variations in runoff behavior from year to year. Two simple stochastic models were proposed, one for synthesizing monthly runoff flow and the other for snowmelt runoff simulation. Bayesian statistics were used for estimating different conditional probabilities of runoff events for subunits within the watershed. When combined with historical runoff records, synthesized runoff flow may improve hydrologic design criteria for engineering structures. Frequency values of annual runoff and maximum one-day runoff also were compared on the basis of extreme value distribution. These results confirmed the previous work of Nicholaichuk showing that runoff results mainly from snowmelt events and revealed a low-runoff producing tendency of the watershed that may be due to the topography. Time series analysis showed that there is no evidence that the climate at Swift Current is becoming drier. (Rochester-PTT)
W89-04215

V-NOTCH WEIR BOXES FOR MEASUREMENT OF SUBSURFACE DRAINAGE SYSTEM DISCHARGES,
Agriculture Canada, Fredericton (New Brunswick). Research Station.
For primary bibliographic entry see Field 7B.
W89-04216

UNCERTAINTY ESTIMATES FOR SURFACE RUNOFF MODELS,
Williamson and Schmid, Irvine, CA.
T. V. Hromadka, and R. H. McCuen.

Advances in Water Resources AWREDI, Vol. 11, p 2-10, March 1988. 13 fig, 1 tab, 8 ref.

Descriptors: *Surface runoff, *Flood control, *Hydrologic models, *Model testing, *Uncertainty, Error analysis, Unit hydrographs, Rainfall distribution, Catchment areas, Flood protection, Calibrations.

The unit-hydrograph method is used to develop estimates of runoff-modeling error in the frequently-occurring cases where the uncertainty in the rainfall distribution over the catchment dominates all other sources of modeling uncertainty. Uncertainty in the precipitation distribution appears to be a limiting factor in the successful development, calibration, and application of all surface-runoff hydrologic models. A lower bound for variance in modeling estimates is advanced. The bound is derived using a linear unit-hydrograph approach which utilizes a discretization of the catchment into an arbitrary number of subareas, a linear routing technique for channel-flow effects, a variable effective-rainfall distribution over the catchment, and calibration-parameter distributions developed in correlating rainfall/runoff data by the model. The uncertainty bound reflects the dominating influence of the unknown rainfall distribution over the catchment and is expressed as a distribution function that can be reduced only by supplying additional rainfall/runoff data. It is recommended that this uncertainty distribution in modeling results be included in flood-control design studies in order to incorporate a prescribed level of confidence in flood-protection facilities. (Shidler--PTT)
W89-04240

DISSIPATIVE FINITE ELEMENT MODEL FOR DISCONTINUOUS UNSTEADY FLOW IN OPEN CHANNEL,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
L. Anastasiadou-Partheniou, and G. Terzidis.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 157-168, June 1988. 7 fig, 29 ref.

Descriptors: *Open channel flow, *Fluid dynamics, *Finite element method, *Unsteady flow, *Statistical models, Hydraulic roughness, Galerkin approximation, Surges, Finite difference methods, Channel morphology.

The traditional Galerkin approximation is inappropriate for simulation of open-channel flow when discontinuities are introduced in the flow domain because the solutions show undesirable oscillations in the vicinity of the discontinuity. The method presented is a weighted residual formulation based on discontinuous weighting functions which are not identical to the shape functions. This method provides smoother and more accurate results than the standard Galerkin approximation, offering to the finite-element method the ability of simulating steep wave fronts. The dissipative model is applied to flow with surges in a rectangular horizontal channel. Computational results are compared with experimental data and with results obtained by finite-difference schemes. (Author's abstract)
W89-04260

STEP-AHEAD STATE FORECASTING USING STREAMFLOW OBSERVATIONS,
Ente Nazionale per l'Energia Elettrica, Mestre (Italy). Servizio Idrologico.
For primary bibliographic entry see Field 6D.
W89-04261

RIVER DYNAMICS AND VEGETATION MOSAICISM: A CASE STUDY OF THE RIVER KAMAJOHKA, NORTHERNMOST FINLAND,
Turku Univ. (Finland).
R. Kalliola, and M. Puhakka.
Journal of Biogeography JBIODN, Vol. 15, No. 5/6, p 703-719, September/November 1988. 8 fig, 4 tab, 43 ref.

Descriptors: *River flow, *Vegetation establishment, *Flooding, *Erosion, *River Kamajohka, Finland, River dynamics, Reparian vegetation, Meanders, Species diversity, Sedimentation, Channel migration.

Vegetation was classified and mapped along the small meandering River Kamajohka in peatlands in northernmost Finland. The results show a mosaic of thirteen communities, mainly woody grasslands and mire types. They may be schematically arranged into a developmental order that represents the flood controlled successions on well drained and poorly drained areas. Channel migration largely determines the boundaries between vegetation groups, and river migration is a natural perturbation factor that causes continuous site turnover. All of the current flood plain vegetation has originated from riparian primary successions, and all riparian vegetation may be destroyed by further river erosion. Some vascular plants benefit from special habitats created by river channel migration, though flood influences (duration and magnitude) are probably the most important factors affecting species distribution. Six recent channel abandonments illustrate the heterogenous nature of sedimentary patterns and vegetation successions; they are important components of the vegetation mosaic along the river. (Author's abstract)
W89-04311

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART I. MODEL DEVELOPMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W89-04384

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART II. MODEL SENSITIVITY ANALYSIS AND TESTING,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W89-04385

APPROXIMATE RIEMANN SOLUTIONS OF THE SHALLOW WATER EQUATIONS,
Reading Univ. (England). Dept. of Mathematics.
P. Glaister.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 293-300, 1988. 8 fig, 15 ref.

Descriptors: *Flow discharge, *Mathematical models, *Shallow water, Riemann solutions.

A finite difference scheme based on flux difference splitting was used to solve the one-dimensional shallow water equations of ideal fluid flow. A linearized problem, analagous to that of Riemann for gas dynamics, is defined and a scheme, based on numerical characteristic decomposition, is presented for obtaining approximate solutions to the linearized problem. The method of upwind differencing is used for the resulting scalar problems, together with a flux limiter for obtaining a second order scheme which avoids non-physical, spurious oscillations. An extension to the one-dimensional equations with source terms, is included. The scheme for the one-dimensional equations was applied to the dam-break problem, and the approximate solution is compared with the exact solution of ideal fluid flow. (Author's abstract)
W89-04419

SIGNIFICANCE OF AQUATIC SURFACE RESPIRATION IN THE COMPARATIVE ADAPTATION OF TWO SPECIES OF FISHES (NOTROPIS CHRYSOCEPHALUS AND FUNDULUS CATENATUS) TO HEADWATER ENVIRONMENTS,
Centre Coll. of Kentucky, Danville. Div. of Science and Mathematics.
For primary bibliographic entry see Field 2H.
W89-04442

GEOCHEMICAL TRACES OF RIVERINE INFLUENCE ON A TROPICAL LATERAL LAKE,
Papua New Guinea Univ., Port Moresby. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-04499

2F. Groundwater

COMPUTER CODES FOR THREE DIMENSIONAL MASS TRANSPORT WITH NONLINEAR SORPTION,
British Geological Survey, Keyworth (England). Fluid Processes Research Group.
For primary bibliographic entry see Field 5B.
W89-03340

QUALITY CONTROL EXPERIMENTS ON ORGANICS IN GROUND WATER AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY, LIVERMORE, CALIFORNIA,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5A.
W89-03358

MEASURING GROUND WATER LEVELS IN WELLS,
Springfield City Utilities, MO.
For primary bibliographic entry see Field 7B.
W89-03394

DISTRIBUTION COEFFICIENTS OF RADIONUCLIDES BETWEEN SOILS AND GROUNDWATERS AND THEIR DEPENDENCE ON VARIOUS TEST PARAMETERS,
British Nuclear Fuels Ltd., Sellafield (England).
For primary bibliographic entry see Field 5B.
W89-03402

DISTRIBUTION AND FORMATION OF HIGH-FLUORINE GROUNDWATER IN CHINA,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
R. Fuhong, and J. Shuqin.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 3-10, August 1988. 5 fig, 6 tab, 6 ref.

Descriptors: *Geochemistry, *Groundwater, *Fluorine, *China, *Groundwater quality, Aquifers, Climates, Soil properties, Coastal plains, Water quality standards, Population exposure, Public health, Poisons.

Groundwater which contains more than 1.0 mg/l fluorine is mainly distributed in shallow aquifers of unconsolidated deposits in arid and semiarid areas, deep aquifers of unconsolidated deposits in semi-arid areas, as well as in bedrock hot springs of mountainous areas and aquifers of fluorite-mine areas. The formation of such groundwater is controlled by regional climate, groundwater seepage, and the hydrogeochemical environment. The physicochemical properties of soil in the aeration zone play an important role in fluorine concentration in shallow groundwater. In coastal plain areas, where groundwater is mainly recharged and discharged vertically, the grain size of soil in the aeration zone directly influences the amount of fluorine transferred from the solid medium into water, and the chemical constituents of this soil control the chemical characteristics of the shallow groundwater, consequently influencing the concentration of fluorine in water. High-fluorine groundwater exceeding the sanitary standard (1.0 mg/l) has an obvious zonality in regional distribution in China. Currently, there are roughly 50 million people in China who have consumed water which exceeds standards. In high-fluorine groundwater areas, different degrees of endemic fluorine-poisoning often arise, affecting human health seriously. At the end of 1983, over 20 million patients were suffering from fluorine poisoning in China. (Author's abstract)
W89-03405

ORIGIN, DISTRIBUTION, AND EVOLUTION OF SALT-FRESH GROUNDWATER IN NORTH JIANGSU BASIN, CHINA,
Academia Sinica, Nanjing (China). Nanjing Inst. of Geology and Palaeontology.
Z. Hongchun.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 15-22, August 1988. 7

fig, 1 tab, 8 ref.

Descriptors: *Geochemistry, *Groundwater, *Saline-freshwater interfaces, *China, Connate water, Salinity, Infiltration, Meteoric water, Sea level, Coastal plains, Dissolved solids, Groundwater movement, Chemical properties, Bicarbonates.

Connate saltwaters are contained within the upper Pleistocene and overlying sediments. The high salinity of phreatic water and subsoil has significant effects on the development of industry and agriculture in the area. Connate saltwaters in the western part and within old dunes in the eastern part of the area have been flushed out by infiltrating meteoric water, since sealevel regression happened about 1000 years ago. A broad transition zone of saltwater to freshwater exists due to repeated eustatic sealevel fluctuations during the Quaternary period, as shown by analysis of relationships between marine beds and the distribution of salt and fresh groundwater. In the coastal plain, the distribution of salt and fresh water is quite complex. There are four types of vertical distribution represented by chloride and/or total dissolved solids profiles: (1) salt/fresh water inversion, (2) salt/brackish water inversion, (3) salt/fresh/brackish water superimposition, and (4) salt/fresh/salt/fresh water superimposition. Groundwater in the middle-layered aquifer system is replenished in some places from the west, and flows slowly eastward. Factors influencing chemical characters of the water include halite dissolution and incongruent dissolution of aluminosilicate minerals, ion exchange and adsorption, and mixture of salt and fresh water. Hydrochemical types evolved from bicarbonate to bicarbonate/chloride; the sulfate type is lacking due to the mixture of salt and fresh water. The Chebotarev hydrochemical evolution sequence is, therefore not relevant. (Author's abstract)
W89-03406

RELATIONSHIP OF KASCHIN-BECK AND KESHAN DISEASES WITH HYDROGEOCHEMISTRY,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2K.
W89-03407

FEATURES OF NATURAL ENVIRONMENT AND OCCURRENCE OF GROUNDWATER IN COLD ARTESIAN BASINS IN PERMAFROST AREAS, CHINA,
Heilongjiang Forestry Design Research Inst., Harbin (China).
L. Feng-Tong.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 43-47, August 1988. 4 fig, 3 tab, 3 ref.

Descriptors: *Groundwater, *Artesian basins, *Permafrost, *China, *Environmental quality, *Cold regions, Glacial aquifers, Field tests, Geophysics, Melting, Air circulation, Temperate zone, Groundwater recharge, Infiltration, Porosity, Interstitial water.

This article is a report on the Huola River artesian water basin in Guilan District, Mohe County, in the Xin-an Region and the interrelationship of various factors of underground water under glacial conditions. Field investigations and geophysical prospecting show that most of the area is underlain by permafrost. There is, however, a considerable percentage in the melting zone, which indicates there has been some change in the cold-produced environment. The change on top of hills surrounding the basin is greater than that near the bottom of the basin. This is the result of numerous melting zones formed under the influence of the inversion layer of the atmospheric circulation in the northern temperate zone, together with strong circulation replacement of surface water, and underground water entering the melting zone through the fracture zone. The thickness of permafrost in the area surrounding the basin is small, and thickness gradually increases towards the center. The Huola River artesian basin is unlike an artesian basin in nonpermafrost zones due to differences in groundwater recharge systems, rate of underground runoff systems, underground water drainage systems, and distribution and storage systems, being controlled by the permafrost; these are usually restraining influences. As the continuity and thickness of permafrost increases, infiltration decreases. Frequent structural movement in the basin's peripheral hills fractures the thick Cretaceous strata within the basin and enlarges and develops the porosity of the coal strata in the basin. The storage, distribution, and runoff conditions of pore-fissure water under the permafrost layer varies with changing environmental conditions. (Shidler-PTT)
W89-03408

GROUNDWATER RESOURCES IN THE NORTH CHINA PLAIN,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
F. Jin.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 63-67, August 1988. 2 fig, 2 ref.

Descriptors: *Groundwater, *Water supply development, *China, Groundwater availability, Surface water availability, Water demand, Water conservation, Water control, Optimum development plans, Artificial recharge.

Shallow groundwater is a major object of exploitation in the North China Plain. About 20 billion cubic m/yr of fresh groundwater and about 20 billion cubic m/yr of surface water are available. Present water demand is about equal to or exceeds the utilizable water resources. Strict economy of water use is needed along with strengthened water control, a restructured development plan, and artificial recharge. (Author's abstract)
W89-03409

IMPROVED ESTIMATES OF GROUNDWATER-MINING ACREAGE,
Economic Research Service, Washington, DC.
C. Dickason.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 3, p 239-240, May/June 1988. 9 ref.

Descriptors: *Irrigation water, *Consumptive use, *Water table decline, *Groundwater mining, Estimating, Irrigation efficiency, Decision making, Pesticides, Fertilizers.

To estimate irrigation's consumptive water use based on single-year water-decline area estimates, the following computations were made: consumptive water-use coefficients developed by the Soil Conservation Service for each subregion and crop type in the United States were combined with the corresponding irrigated crop acreage data for the 1982 census to obtain a weighted-average plant irrigation consumptive-use coefficient for each subregion. Each of these latter coefficients was then divided by the appropriate subregional on-farm irrigation-efficiency-percentage coefficient to obtain the average per-acre irrigation consumptive use for the groundwater-mining subregions. These consumptive-use rates were then multiplied by the corresponding acreages within each groundwater-mining subregion to obtain the acre feet of groundwater used in 1982. Single-year estimates of water-decline irrigated acres greatly improve the foundation for estimating certain annual-basis values useful to managers of agribusiness firms and to public decision makers. Among these annual-basis values are acre feet of water consumed and amounts of pesticides and fertilizers applied. Especially important to federal decision makers concerned with influencing farm-production decisions would be a continuing series of annual-basis estimates revealing the trend of irrigated production as it depends on declining water supplies. (Shidler-PTT)
W89-03420

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W89-03553

DATA CHARACTERISTICS: GROUNDWATER MONITORING'S 'CATCH 22',
IBM Corp., Hopewell Junction, NY. General Technology Div.
For primary bibliographic entry see Field 7C.
W89-03600

STATISTICAL COMPARISONS OF GROUNDWATER QUALITY UNDERLYING DIFFERENT LAND USES IN CENTRAL FLORIDA,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 7C.
W89-03602

RADIOACTIVITY IN SPRING WATER AND SURFACE WATER OF SOUTHERN NEVADA,
Environmental Monitoring Systems Lab., Las Vegas, NV.
C. K. Liu, S. Faller, J. Carilli, and R. W. Holloway.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 155-156.

Descriptors: *Radioactivity, *Nevada, *Spring water, *Surface water, *Groundwater, *Water pollution sources, Aquifers, Groundwater pollution, Connate water, Evaporation, Uranium, Pahranagat Lake.

The concentration of several radionuclides were measured in several springs and other surface waters believed to originate from reserves of fossil water rock formations beneath the desert of Southern Nevada. The samples were analyzed for tritium, radon, uranium, thorium and plutonium. For spring waters, virtually no contamination from artificial radioactivity was found, but natural radionuclides (such as radon, uranium and thorium) were detected. Water from Pahranagat Lake appears to be substantially enriched in uranium compared to its feeder springs, probably due to evaporation. The absence of tritium in most of these springs indicates that the water has not mixed with surface water after the early 1950's. (See also W89-03595) (Author's abstract)
W89-03608

RELATIONSHIP OF RADIUM AND RADON WITH GEOLOGICAL FORMATIONS,
RPI International, Inc., Columbia, SC.
For primary bibliographic entry see Field 2K.
W89-03610

AUTOMATED DATA ACQUISITION AND ANALYSIS: APPLICATION TO THE DETERMINATION OF VOLATILE ORGANIC CONTAMINANTS IN GROUNDWATER,
S-Cubed, La Jolla, CA.
For primary bibliographic entry see Field 5A.
W89-03643

INCORPORATING PARAMETER UNCERTAINTY INTO GROUNDWATER QUALITY MANAGEMENT MODELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03704

KINETIC AND EQUILIBRIUM FORMULATIONS IN MODELLING OF HYDROPHOBIC ORGANIC CHEMICALS IN SURFACE AND GROUND WATERS,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03712

ENGINEERING AND ENVIRONMENTAL GEOLOGY OF THE INDIAN WELLS VALLEY AREA,
Naval Weapons Center, China Lake, CA.
For primary bibliographic entry see Field 4C.
W89-03742

APPRAISAL OF WATER RESOURCES OF THE BOULDER AND STILLWATER RIVER BASINS, INCLUDING THE STILLWATER COMPLEX, SOUTH-CENTRAL MONTANA,
Geological Survey, Billings, MT.
R. D. Feltis, and D. W. Litke.
Montana Bureau of Mines and Geology Memoir 60, 1987. 121p, 17 fig, 10 tab, 91 ref, 11 append.

Descriptors: *Montana, *Geochemistry, *Heohydrology, *Groundwater, *Water quality, *Groundwater quality, Dissolved solids, Aquifers, Alluvial aquifers, Limestone, Geology, Subsurface mapping, Water analysis.

The Stillwater Complex consists of Precambrian metamorphosed intrusive rock that is approximately 18,000 ft thick and 30 mi long in the Beartooth Mountains of south-central Montana. Groundwater in the area occurs in four general physiographic-geologic settings: (1) the alpine area of Precambrian metamorphic rocks of the Beartooth Mountains (includes the Stillwater Complex); (2) the limestone and dolomite of Paleozoic age along the mountain front; (3) the steeply dipping to flat-lying clastic sedimentary and igneous extrusive rocks of Mesozoic and Cenozoic age in the upland plains; and (4) Tertiary and Quaternary alluvial and glacial material along valleys of the principal drainage systems. The dissolved solids concentrations in water from 125 of 130 groundwater sampling sites range from 42-5442 mg/L. These samples are from a wide variety of aquifers in the Beartooth Mountains, the plains area and alluvial valleys. Most of these waters are a calcium bicarbonate type and some are a sodium bicarbonate type. Five remaining samples have dissolved solids concentrations ranging from 718-1,980 mg/L; these samples represent water from a mineralized zone in the Stillwater Complex along Verdigris Creek, two wells that penetrate the Cretaceous Colorado Group, an oil well at McLeod that penetrates Paleozoic limestones, and a well in the Cretaceous Hell Creek Formation north of the Yellowstone River. These waters are calcium sulfate, sodium sulfate and sodium bicarbonate types. Water samples for chemical analysis were collected at 39 stream sites. The analyses include major ions, total or total-recoverable trace elements for all samples, and dissolved trace elements for peak-flow samples. Dissolved solids concentrations range from 19 mg/L in some streams draining resistant Precambrian rocks of the Beartooth Mountains to 320 mg/L where irrigation return flow and fine-grained marine Cretaceous rocks affect the water quality. (Lantz-PTT)
W89-03756

HYDROLOGIC DATA FOR CECIL COUNTY, MARYLAND,
Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2E.
W89-03758

PREMINING HYDROLOGY OF THE LOGANSPORT LIGNITE AREA, DE SOTO PARISH, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
J. L. Snider, and K. J. Covay.
Louisiana Department of Transportation and Development Water Resources Technical Report No. 41, 1987. 65p, 15 fig, 15 tab, 1 plate, 52 ref.

Descriptors: *Hydrologic data, *Lignite, *Louisiana, *Strip mines, *Surface water, Aquifers, Water analysis, Chemical analysis, Streamflow, Runoff, Dissolved solids, Invertebrates, Bacteria, Hydrology, Logansport, Sedimentation, Sediment load.

Surface mining of lignite would involve dewatering and removing aquifers above the lignite beds in the Logansport area, De Soto Parish, Louisiana. The major lignite bed occurs near the base of the Naborton Formation (of the Wilcox Group) at depths ranging from 180 to 230 ft below land surface. The lignite ranges from 4 to 17 ft in thickness and averages about 9 ft. The principal aquifers that will be affected are the Naborton and Dolet Hills zones of the Carrizo-Wilcox aquifer. Water in aquifers of the Carrizo-Wilcox aquifer moves from the interstream recharge areas to discharge areas in the Sabine River valley (mostly covered by Toledo Bend Reservoir). There is also lateral movement into the project area from potentiometric highs in the south-central part of De Soto Parish. Streamflow at Bayou Castor and Bayou Grand Cane is sustained from groundwater sources but also reflects direct runoff from rainfall. The greatest total discharge, 39,306 cu ft/sec, occurred at Bayou Castor near Funston during the 1983 water year. Analysis of suspended sediment data for Bayou Grand Cane and Bayou Castor indicates that maximum sediment discharge occurs in the winter and spring and corresponds to periods of maximum streamflow. The maximum total monthly load at Bayou Grand Cane was 3,090 tons and at Bayou Castor was 2,750 tons. Chemical data at Bayou Grand Cane near Stanley and Bayou Castor near Logansport indicate that the water is often a sodium-calcium bicarbonate type. Sulfate and chloride occasionally can be codominant anions. Dissolved solids ranged from 72 to 185 mg/L at Bayou Grand Cane near Stanely and ranged from 84 to 178 mg/L at Bayou Castor near Logansport. Benthic invertebrates consist primarily of the order Diptera and the tubificid worms. Analysis of fecal streptococci bacteria indicates that colony counts of 5,000 colonies/100 ml can occur at Bayou Castor near Logansport. (Lantz-PTT)
W89-03759

GROUND-WATER LEVELS FROM THE MARYLAND OBSERVATION-WELL NETWORK, 1943-86,
Maryland Geological Survey, Baltimore.
M. J. Smigaj, and R. G. Davis.
Maryland Geological Survey Basic Data Report No. 17, 1987. 234p, 8 fig, 1 tab, 1 plate, 65 ref.

Descriptors: *Groundwater level, *Maryland, *Observation wells, Groundwater quality, *Hydrologic data collections, Aquifers, Geohydrology, Well data, Well hydrographs.

Water level data are presented for 122 groundwater wells in the Maryland Observation-Well Network; the data began as early as April 1943 and extend through December 1986. Water level tables and hydrographs are given for each well, along with a description of the well characteristics, location, owner, aquifer, altitude, period of record, the extremes for the period of record, and pertinent remarks. Also included are brief discussions of the hydrologic settings in Maryland and factors that affect groundwater levels, such as recharge, movements of the Earth, Sun and Moon, earthquakes, groundwater withdrawals, construction and mining. (Lantz-PTT)
W89-03760

LAND SUBSIDENCE, EARTH FISSURES, AND WATER-LEVEL CHANGE IN SOUTHERN ARIZONA,
Arizona Bureau of Geology and Mineral Technology, Tucson.
For primary bibliographic entry see Field 6G.
W89-03761

WATER RESOURCES OF SOUTHERN COCONINO COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
E. H. McGavock, T. W. Anderson, O. Moosburner, and L. J. Mann.
Arizona Department of Water Resources Bulletin 4, 1986. 53p, 9 fig, 6 tab, 2 plates, 43 ref.

Descriptors: *Data collection, *Hydrologic data collections, *Water resources, *Arizona, *Groundwater supply, *Surface waters, Water quality, Streamflow, Dissolved solids, Water use, Groundwater mining, Groundwater recharge, Coconino County.

Southern Coconino County includes about 10,600 sq mi in north-central Arizona. Water resources development has been slight, and less than 8,000 acre-ft of groundwater and surface water was used in 1975. The amount of groundwater in storage is estimated to be between 100 and 200 million acre-ft. The main sources of groundwater are the Coconino and limestone aquifers. The Coconino aquifer includes three principal formations, which in ascending order are the Supai Formation, Coconino Sandstone, and Kaibab Limestone of Pennsylvanian and Permian age. Streamflow is extremely variable, and most streams are intermittent. Chemical quality of flow in intermittent and perennial streams during medium to high flows generally is acceptable for most uses; dissolved-solids concentrations generally are less than 200 mg/l. Dissolved solids concentrations in low flows in the perennial streams range from 200 to 2,000 mg/l. In southern Coconino County about 2,600 acre-ft of groundwater and 4,200 acre-ft of surface water was used for public supply and irrigation in 1970. In 1975 about 5,200 acre-ft of groundwater was withdrawn and about 2,500 acre-ft of surface water was used. The amount of surface water used annually is dependent on the amount of precipitation and is extremely variable. Groundwater withdrawals have not exceeded the rate of recharge, and water levels have been nearly constant. (Lantz-PTT)
W89-03764

STUDY OF THE INTER-RELATION BETWEEN SHALLOW AND DEEP AQUIFERS IN MARDAN VALLEY, PAKISTAN,
Pakistan Inst. of Nuclear Science and Technology, Islamabad.
M. I. Sajjad.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-700607. Price codes: A03 in paper copy, A01 in microfiche. Report No. IAEA-R-3620-F, April 1987. 39p, 21 fig, 2 tab, 5 ref.

Descriptors: *Geohydrology, *Groundwater, *Aquifers, *Pakistan, Groundwater level, Water table, Water table rise, Irrigation, Groundwater supply, Permeability, Canals.

The area on the west side of the river Indus includes the districts of Mardan, Peshawar, Kohat, Bannu and D.I. Khan and consists of small valleys, generally surrounded by low, erodable hills. The biggest valley is that of the Mardan district. Its gross area under irrigation constitutes at 190,000 hectares. The prosperity of the project area depends on the availability of irrigation water supply from the Swat River. The Upper Swat Canal, was taken out of the river Swat at Amandara in 1915. It crosses the ranges of Malakand hills through a tunnel, and irrigates large areas lying to the East of Mardan. The canal infiltration has resulted in a serious problem of waterlogging on the low lying areas. At some places water can even be seen at the surface. Groundwater occurs largely in two zones: (i) a shallow unconfined zone and (ii) a deep confined zone. The shallow groundwater zone receives its recharge directly from irrigation channels and rainfall. The low permeability and generally large thickness of the deposits underlying this zone restrict subsurface drainage and create a high water table condition over a considerable area. Water-logging in the area is mainly due to the irrigation canal system. However, in some zones the upward leakage from the deep confined aquifer also contributes to this effect. There is no quick movement of groundwater in the area and the residence time is in the order of tens of years. Quality of deep groundwater is better than that of the shallow groundwater. (Lantz-PTT)
W89-03766

WATER RESOURCES INVENTORY OF CONNECTICUT. PART 10: LOWER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-03772

HYDROLOGY OF A STREAM-AQUIFER SYSTEM IN THE CAMP VERDE AREA, YAVAPAI COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
S. J. Owen-Joyce.

Arizona Department of Water Resources Bulletin 3, 1984. 60p, 14 fig, 6 tab, 3 plates, 25 ref.

Descriptors: *Groundwater management, *Groundwater quality, *Surface-groundwater relations, *Aquifers, *Streams, *Arizona, *Irrigation, Hydrologic studies, Runoff, Evapotranspiration, Groundwater movement, Arsenic, Dissolved solids, Sulfates, Ammonia.

A dynamic interaction between the distribution of 30,000 acre-ft of water diverted from the Verde River to irrigate fields on the alluvium and the inflow of above 1,000 acre-ft of water from the under-lying artesian aquifer in the Verde Formation determines the quantity and quality of water in the alluvium south of Camp Verde, Arizona. About 70% or 21,800 acre-ft of the diverted irrigation water returns to the Verde River as subsurface flow, which with 14,000 acre-ft of water flowing through the alluvium from West Clear Creek to the Verde River flushes the alluvial aquifer. About 9,300 acre-ft of water is lost to evapotranspiration. Groundwater in the alluvium is unconfined and hydraulically connected to the Verde River and Verde Formation. Groundwater inflow to the alluvium from the Verde Formation occurs in areas where the hydraulic head in the Verde Formation is higher than the hydraulic head in the alluvium; wells open to both formations are another path of groundwater inflow. Saturated thickness in the alluvium ranged from 0 to about 30 ft in February to April 1981; the annual minimum amount of water stored in the alluvium occurs prior to irrigation and was estimated to be 17,500 acre-ft. Groundwater for most of the alluvium contained more than the maximum contaminant level for dissolved solids and in some areas contained more than the maximum contaminant levels for sulfate, chloride, and arsenic in public water supplies proposed by the U.S. EPA and the State of Arizona. Dissolved solids concentrations ranged from 251 to 4,400 mg/L; 85% of the samples exceeded 500 mg/L. Locally, the presence of reworked Verde Formation deposited in the alluvium causes large concentrations of dissolved solids and sulfate particularly downslope from the salt mine. Ammonia concentrations ranged from 0.01 to 0.25 mg/L; more than 0.1 mg/L generally indicates organic pollution. (Lantz-PTT)
W89-03773

GROUND-WATER RESOURCES OF THE FORT BELKNAP INDIAN RESERVATION, NORTH-CENTRAL MONTANA: POTENTIAL SOURCES OF GROUND WATER FOR IRRIGATION, DOMESTIC AND MUNICIPAL SUPPLY,
Geological Survey, Billings, MT.
For primary bibliographic entry see Field 4B.
W89-03778

APPRAISAL OF THE GROUNDWATER RESOURCES OF BARTON, VERNON, AND BATES COUNTIES, MISSOURI,
Geological Survey, Rolla, MO.
M. J. Kleeschulte, T. O. Mesko, and J. E. Vandike.
Missouri Department of Natural Resources, Division of Geology and Land Survey, Water Resources Report No. 36, 1985. 74p, 27 fig, 11 tab, 1 plate, 30 ref.

Descriptors: *Hydrologic data, *Aquifers, *Water resources data, *Groundwater supply, Groundwater recharge, Water resources, Water quality, Precipitation, Saline water intrusion, Calcium, Magnesium, Bicarbonate, Sodium chloride.

Groundwater resources in Barton, Vernon, and Bates Counties, Missouri, are limited by aquifer characteristics and restricted by water quality. The Pennsylvanian aquifer, consisting of cyclic deposits of clastic and carbonate rocks, yields approximately 1 to 40 gallons per minute (gpm) to domestic wells in the northern and western parts of the study area. The Pennsylvanian aquifer principally is recharged by precipitation. The water level generally is from 15 to 40 ft below land surface, and water movement is toward stream and river valleys. Because the Pennsylvanian aquifer is a leaky confining layer, water probably moves through it and recharges the underlying Mississippian aquifer. A comparison of the historical and current water level measurements shows that throughout a long time, discharge is balanced by recharge in the Pennsylvanian and Mississippian aquifers. Water levels in the two have not been significantly affected during the past 40 years, except for local drawdowns in the Mississippian aquifer, in places where water is intensively pumped. The Cambrian-Ordovician aquifer is mostly recharged by precipitation on the Salem Plateau, where this system crops out. A transition zone diagonally crossing the three counties separates freshwater in the southeast from saline water in the northwest. Despite an increase in groundwater withdrawals during recent years, the location of the freshwater-saline water transition zone has not substantially changed, although minor fluctuations have occurred along the boundary zone. Water from public-supply wells in Barton and Vernon Counties, however, has changed from a calcium magnesium bicarbonate-type to a sodium chloride-type, with no appreciable change in dissolved-solids concentrations. (Lantz-PTT)
W89-03780

WATER RESOURCES INVESTIGATIONS IN MISSISSIPPI, 1982-83.
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-03781

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-03784

USING MODELS TO SOLVE GROUND WATER QUALITY PROBLEMS,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 5G.
W89-03790

ESTIMATES OF CONSUMPTIVE USE AND GROUND-WATER RETURN FLOW USING WATER BUDGETS IN PALO VERDE VALLEY, CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-03792

PUBLIC TUBEWELL DEVELOPMENT IN THE STATE OF UTTAR PRADESH, INDIA,
For primary bibliographic entry see Field 3F.
W89-03796

TWIN LAKE TRACER TESTS: SETTING, METHODOLOGY, AND HYDRAULIC CONDUCTIVITY DISTRIBUTION,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
R. W. D. Killey, and G. L. Moltayner.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1585-1612, October 1988. 14 fig, 7 tab, 35 ref.

Descriptors: *Data acquisition, *Measuring instruments, *Tracers, *Sand aquifers, *Radioactive tracers, *Groundwater movement, *Hydraulic conductivity, Gamma-emitting radionuclide.

Following evaluation of 3 potential sites, a fluvial sand aquifer with high (0.7-1.6 m/d) linear average groundwater flow velocities was instrumented with a fully penetrating injection well and 82 monitoring installations over a 40-m flow path length. Two natural gradient tracer migration experiments have employed pulse injections of a nonreactive radioisotope (I-131) in a study of hydraulic conductivity structure and dispersive characteristics of the flow system. The use of a gamma-emitting radionuclide in these experiments allowed measurement of tracer distribution by scanning fully penetrating boreholes with a scintillation detector. This technique provided many advantages in data collection over conventional tracers, including unprecedented resolution of the vertical distribution of tracer, measurements without pumping and the attendant concerns for flow system perturbation, and minimal manpower for sample analysis. Tracer breakthroughs at monitors along the axis of flow revealed the presence of heterogeneities in aquifer hydraulic conductivity at 2 scales. Over the 40-m path length, 6 regions with hydraulic conductivities substantially different for adjacent strata were identified. Thicknesses of these regions varied from 0.2 to more than 3 m; their lateral extents (in the direction of groundwater flow) ranged from 15 m to more than 40 m. Smaller strata, with an average thickness of 0.34 m and lengths of less than 10 m, were detected within all 6 of the hydraulic conductivity regions, but there was no evidence of increases in local dispersivity with increased transport distance as a result of these variations. The 6 hydraulic conductivity regions do, however, have measurable effects on whole-aquifer dispersion. Stratification characteristics of the tested aquifer, believed to have been deposited in a sandy braided river, are consistent with those observed in similar modern environments. Estimation of the magnitude and spatial structure of hydraulic conductivity variations in aquifers of concern would be greatly aided by studies of the stratification characteristics in well-exposed modern or lithified sedimentary analogues. (See W89-03800 and W89-03801) (Author's abstract)
W89-03799

TWIN LAKE TRACER TESTS: LONGITUDINAL DISPERSION,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
G. L. Moltayner, and R. W. D. Killey.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1613-1627, October 1988. 13 fig, 6 tab, 16 ref.

Descriptors: *Tracers, *Path of pollutants, *Dispersion, *Sand aquifers, *Radioactive tracers, *Groundwater movement, Hydraulic conductivity, Porous materials, Model studies.

Two natural gradient dispersion tests were conducted at the Chalk River Nuclear Laboratories, Ontario, in 1982 and 1983 in order to quantify field-scale dispersion processes over a 20- and 40-m distance of a radiotracer migration. The patterns of dispersion that were observed in the field using a dry access tube monitoring technique were compared with patterns predicted by the advection-dispersion model with constant parameters. Analysis of the time-concentration profiles of the tracer at observation wells located along the mean direction of the longitudinal spreading showed that the dispersion model adequately describes the dispersion patterns actually observed and averaged over the aquifer depth. The values of longitudinal dispersivity determined from continuous time-concentration profiles were virtually equal to those obtained from laboratory-scale columns. The dispersive properties of the aquifer were characterized at the local scale by a constant independent of travel distance dispersivity value of 0.0045 m. Averaging the test data over the aquifer depth, analogous to the information provided by a fully penetrating pumping well, yielded a full-aquifer dispersivity varying in an irregular fashion from 0.16 to 0.06 m The scale effect observed between local-scale and full-aquifer dispersivities is the result of inhomogeneity of the aquifer and the concentration averaging produced by the sampling instrumentation. The results of the 2 tracer tests also showed that the use of the dry access tube monitoring technique for field experimentation provides detailed representation of spatial and temporal distribution of a radiotracer's activity and, consequently, provides a practical means to determine the groundwater velocity field and dispersive properties of porous materials. (See W89-03899 and W89-03801) (Author's abstract)
W89-03800

TWIN LAKE TRACER TESTS: TRANSVERSE DISPERSION,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
G. L. Moltayner, and R. W. D. Killey.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1628-1637, October 1988. 9 fig, 4 tab, 11 ref.

Descriptors: *Tracers, *Path of pollutants, *Dispersion, *Sand aquifers, *Radioactive tracers, *Groundwater movement, Hydraulic conductivity.

Two natural-gradient dispersion tests were performed at the Chalk River Nuclear Laboratories in Ontario in 1982 and 1983. During the field tests I-131 was used to label the groundwater, and its activity was measured in situ, collecting continuous records of activity versus depth at selected times and of activity versus time at selected locations. Curves generated by a 3-dimensional analytical solution to the advection dispersion equation were fit to activity versus depth scans recorded at various locations in the test aquifer. Within the individual velocity regions the vertical dispersivities were 0.0006 and 0.0008 m, with the arithmetic average 0.0012 m. The increase in dispersivity was attributed to the error associated with the sampling and fitting procedures. The average vertical dispersivity of the tracer test aquifer was an order of magnitude less than the average longitudinal dispersivity (0.0010 m versus 0.010 m for the intermediate-velocity region). Within individual velocity regions the vertical dispersivity of the porous medium was independent of the travel distance of the tracer and was proportional to the velocity. (See W89-03799 and W89-03800) (Author's abstract)
W89-03801

INFLUENCE OF BASIN MORPHOLOGY ON GROUNDWATER OUTFLOW,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
Y. B. Zecharias, and W. Brutsaert.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1645-1650, October 1988. 1 fig, 2 tab, 26 ref.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Geomorphology, *Geohydrology, Watersheds, Groundwater discharge, Outflow.

Twenty geomorphologic parameters which constitute a well-balanced representation of the area, length, elevation, form, and shape aspects of watersheds as well as the texture of their drainage networks were considered. On the basis of groundwater theory and the results of previous related studies, eight of these parameters were identified as being relevant to the process of groundwater discharge. Values of the selected parameters were obtained for representative watersheds located in a section of the Appalachian Plateaus. The data, which were generated from U.S. Geological Survey topographic maps, were then subjected to as factor analysis to assess the relative importance of the parameters with respect to their influence on groundwater outflow behavior. The analytical results and their interpretation showed that among the parameters that are related to groundwater outflow, total length of perennial streams, average basin slope, and drainage density are the ones that are most closely related to the process. The influences of these parameters on groundwater outflow behavior are independent of each other. Thus in relating groundwater outflow characteristics to basin morphology, only these parameters need be considered and the inclusion of additional parameters does not necessarily yield a better relationship and may result in redundancy. The findings of the study are consistent with existing concepts regarding base flow (or drought flow) and have been confirmed by an independent study that investigated the process based on a more mechanistic approach. (Author's abstract)
W89-03803

RECESSION CHARACTERISTICS OF GROUNDWATER OUTFLOW AND BASE FLOW FROM MOUNTAINOUS WATERSHEDS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
Y. B. Zecharias, and W. Brutsaert.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1651-1658, October 1988. 4 fig, 3 tab, 34 ref.

Descriptors: *Groundwater recession, *Groundwater movement, *Base flow, *Watersheds, *Mountains, *Geomorphology, *Geohydrology, Groundwater discharge.

The relationship between base flow recession characteristics in steep watersheds and geomorphologic and soil parameters is investigated. The formulation for the groundwater outflow was obtained by means of a hydraulic approach applied to a simple conceptual model for a hillslope. Long-term flow data of 19 representative basins in the Allegheny Mountain section of the Appalachian Plateaus were analyzed on the basis of this formulation. The reaction factor, which is a time scale of base flow recession, is dependent on the mean land slope, the drainage density, and the ratio (K/f) of the hydraulic conductivity and the drainable porosity. On account mainly of the nonuniform distribution of the physical characterisitics within a basin, the reaction factor for a given watershed is somewhat variable with time, but the adoption of a constant value is useful to represent average conditions for a recession period. Analysis of the (K/f) dependency showed that macropores and other structural features may greatly affect the watershed base flow. Evaporation form groundwater appears to constitute only a minor portion of overall basin evaporation. (Author's abstract)
W89-03804

EROSION OF COHESIONLESS SEDIMENT BY GROUNDWATER SEEPAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W89-03805

GROUNDWATER CIRCULATION IN A CLOSED DESERT BASIN: TOPOGRAPHIC SCALING AND CLIMATIC FORCING,
Utah Water Research Lab., Logan.
C. J. Duffy, and S. Al-Hassan.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1675-1688, October 1988. 15 fig, 2 tab, 30 ref.

Descriptors: *Geomorphology, *Groundwater movement, *Closed basins, *Climates, *Deserts, *Topography, *Scaling, Mathematical models, Solute transport, Climatic influence, Topographic scaling.

The circulation of groundwater and solutes in a closed basin in western Utah (Pilot Valley) is studied to gain insight into the climatic processes driving flow in this desert environment. The study area is located within the Great Basin portion of the Basin and Range Physiographic Province, a region which is hydrologically closed with no outlet except to the atmosphere. The distinctive topography of steep mountains adjacent to flat playas has a major influence on the climatic and hydrologic patterns of the region. A scaling relationship is found for the distribution of elevation in Pilot Valley, suggesting that the mountain slopes are self-similar. This relationship is used to approximate the spatial distribution of orographic precipitation and recharge for groundwater model input. On the playa, or discharge zone, high evaporation rates produce concentrated brine solutions which lead to large horizontal and vertical density gradients in underlying groundwater. Numerical experiments demonstrate the existence of a free convection cell and recirculation of solutes under the playa and towards the basin margin. The motion of the salt nose which forms is a result of a balance between the buoyancy velocity of the evaporating brines on the playa and recharge from the mountain range. A Rayleigh number for solutes is defined for basin scale hydroclimatic parameters. The simulated flow pattern is consistent with field observations in Pilot Valley and elsewhere, in that both fresh and brackish springs emerge along the margin of the playa. The concept of recirculation may also account for the apparent 'loss' of salts in closed lakes as a subsurface storage mechanism. (Author's abstract)
W89-03806

STOCHASTIC ANALYSIS OF BOUNDARIES EFFECTS ON HEAD SPATIAL VARIABILITY IN HETEROGENEOUS AQUIFERS: I. CONSTANT HEAD BOUNDARY,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
Y. Rubin, and G. Dagan.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1689-1697, October 1988. 8 fig, 30 ref.

Descriptors: *Boundary processes, *Pressure head, *Aquifers, *Groundwater movement, Hydraulic conductivity. effects.

The spatial variability of log transmissivity Y and head H in aquifers assumes a major role in determining the solutions of the direct flow problem, as well as of the inverse problem. Investigation of the joint Y,H variability has been cast in the past in numerical and analytical frames. Analytic solutions for the Y,H statistical moments in 2 dimensions assumed the flow to occur in an unbounded domain. In this study, exact analytical expressions for the Y, H moments are derived, which account for the presence of a given head boundary in a half plane. This result is achieved by a first-order approximation and for and exponential Y covariance. The result offers the opportunity to examine the effects of boundaries on the semivariogram of H and on the Y, H cross covariance. The assumption of unbounded domain is examined and shown to be accurate at distances larger than 2 Y integral scales from the boundary. By using conditional probabilities, a general and simple method to estimate the moments close to the boundary is presented. It requires the knowledge of the moments of Y and H in the unbounded domain only. The method is compared with the exact analytic solution, showing excellent results. (Author's abstract)
W89-03807

STOCHASTIC IDENTIFICATION OF RECHARGE, TRANSMISSIVITY, AND STORATIVITY IN AQUIFER TRANSIENT FLOW: A QUASI-STEADY APPROACH,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
G. Dagan, and Y. Rubin.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1698-1710, October 1988. 8 fig, 5 tab, 27 ref.

Descriptors: *Stochastic models, *Aquifers, *Groundwater movement, *Groundwater recharge, *Transmissivity, *Groundwater storage, Transient flow, Israel.

A stochastic method to identify aquifer natural recharge, storativity, and transmissivity under transient conditions is developed. Four main assumptions were adopted: Y, the log transmissivity, is a normal random space function, the aquifer is unbounded, a first-order approximation of the flow equation is adopted, and the transients are slowly varying. Based on these assumptions, the expected value of Y and of the head H, as well as their covariances and crossvariances, are expressed by analytical equations which depend on a parameters vector theta. Expressions based on the 2-dimensional flow equation have been developed elsewhere. The proposed solution of the inverse problem is a double-stage procedure. First, theta is identified stochastically, by a maximum likelihood procedure applied to the measurements of Y and H. Then, theta serves to estimate the spatial distributions of Y and H through their first 2 statistical moments based on transient head data and in the presence of pumping-recharging wells; the identification of the storativity and the stochastic identification of natural recharge. Since the proposed method makes use of the analytical solution of the flow equation, it saves the need of laborious nu-

merical schemes. Application of the method to a section of the Israeli Coastal Aquifer illustrates its potential in a real-life case. (Author's abstract)
W89-03808

STOCHASTIC ANALYSIS OF SOLUTE ARRIVAL TIME IN HETEROGENEOUS POROUS MEDIA,
Geological Survey, Reston, VA. Water Resources Div.
A. M. Shapiro, and V. D. Cvetkovic.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1711-1718, October 1988. 5 fig, 15 ref, append.

Descriptors: *Path of pollutants, *Stochastic models, *Porous media, *Groundwater movement, *Solute transport, Hydraulic conductivity, Advection.

Longitudinal advective solute movement in heterogeneous porous media is investigated by considering the solute arrival time at a plane perpendicular to the mean fluid velocity. The moments of the solute arrival time are defined in terms of the stochastic properties of a statistically anisotropic hydraulic conductivity field. the flux-averaged concentration is specified by introducing the moments of the arrival time into a probability density function for the arrival time. The quadratic dependence of the arrival time variance on position in the vicinity of an injection point is indicative of a nondiffusive process. For the assumed spatial correlation of the hydraulic conductivity, the variance of the arrival time asymptotically approaches a linear dependence on the position from the injection point similar to a diffusion process. The impact of assuming solute movement to be a diffusive process from the onset of the solute injection causes erroneous estimates of flux-averaged concentrations at distances from the injection point that are of the order of the correlation length of the hydraulic conductivity. The arrival time analysis and the particle position analysis given in Dagan (1982, 1984) are complementary interpretations of advective solute movement that yield different definitions of the solute concentration; the position analysis intrinsically defines the resident or volume-averaged concentration, while the flux-averaged concentration is defined from the arrival time analysis. The temporal variation of the resident and flux-averaged concentration are similar at a given position for small values of the variance of the hydraulic conductivity, or at distances from the solute injection point that are large relative to correlation length of the hydraulic conductivity. (Author's abstract)
W89-03809

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: I. THEORY,
Notre Dame Univ., IN. Dept. of Civil Engineering.
D. J. Kirkner, and H. Reeves.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1719-1729, October 1988. 2 tab, 19 ref.

Descriptors: *Geochemistry, *Path of pollutants, *Numerical analysis, *Mass transfer, *Groundwater movement, *Solute transport, *Chemical reactions, Chemical analysis.

An analysis is presented of several methods for approximately solving the equations governing multicomponent mass transport with homogeneous and heterogeneous chemical reactions. A derivation of the governing equations allowing a fairly general description of the chemistry is given. A number of different formulations are possible depending on the choice of primary variables. Discretization of the governing equations reduces the problem of solving a set of nonlinear algebraic equations each time step. The choice of method to solve the algebraic equations should be based on the nature of the chemical reactions. An analysis of the equations yields recommendations in some cases and direction for numerical experimentation in others. (See also W89-03811) (Author's abstract)
W89-03810

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: II. NUMERICAL RESULTS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
D. J. Kirkner, and H. Reeves.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1730-1739, October 1988. 7 fig, 2 tab, 8 ref, append.

Descriptors: *Numerical analysis, *Path of pollutants, *Mathematical models, *Chemical reactions, *Mass transfer, *Groundwater movement, *Solute transport, Chemical analysis, Homogeneity, Heterogeneity.

The relative efficiency of competing algorithms is evaluated as a function of the nature of the chemistry. The first, formulation A, introduces the total soluble concentration of each component as the primary dependent variable. The second, with variants B and C, introduces the total component concentration, aqueous plus all solid forms, as the primary dependent variable. Finite element discretization in space and a single-step, implicit time marching scheme reduces the problem to a set of nonlinear algebraic equations in each time step. Several versions of Newton-Raphson iteration and Picard iteration are evaluated for the basic formulations by studying a set of single- and 3-component problems. the specific cases studied are each designed in order to emphasize a particular aspect of the equilibrium chemical reactions. Overall, a modified Newton-Raphson iteration apparently is the most efficient solution strategy for the range of problems considered. (See also W89-03810) (Author's abstract)
W89-03811

MODEL PREDICTIONS OF THE SVARTSENGI RESERVOIR, ICELAND,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
G. S. Bodvarsson.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1740-1746, October 1988. 14 fig, 19 ref.

Descriptors: *Model studies, *Geohydrology, *Geothermal resources, *Iceland, Exploitation, Pressure drawdown, Recharge.

Several models have been developed concerning the Svartsengi geothermal field and used to predict the future pressure drawdown due to exploitation. These are based upon different reservoir geometries and recharge pattern. All of them neglect the effect of a 2-phase zone overlying the main reservoir parameters. A simple numerical model developed which assumes that the main reservoir is radial and is connected to an overlying two-phase zone. The model was used to obtain a history match with the pressure decline in the reservoir for the period 1978-1983. The following results were obtained. (1) a radial model can explain the pressure declining in the field, providing there is a high mobility zone surrounded by a lower-mobility region; (2) the pressure decline cannot be matched using only a single-phase liquid reservoir; (3) the zone with different fluid mobilities may be explained in terms of a 3-square-km hot water zone surrounded by colder fluids; (4) the areal extent of the two-phase zone is estimated to by approximately 1 square km, which appears more reasonable than 6 square km obtained by an earlier model; (5) models based upon different reservoir geometries can match the Svartsengi data, but htey give drastically different pressure decline predictions. Thus it is extremely important to gather appropriate data that helps determine the reservoir geometry. (Brock-PTT)
W89-03812

ALTERNATIVE VIEW ON THE ORIGIN OF CHEMICAL AND ISOTOPIC PATTERNS IN GROUNDWATER FROM THE MILK RIVER AQUIFER, CANADA,
National Water Well Association, Dublin, OH.
M. J. Hendry, and F. W. Schwartz.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1747-1763, October 1988. 12 fig, 3 tab, 22 ref.

Descriptors: *Water chemistry, *Geochemistry, *Groundwater, *Connate water, *Meteoric water, *Canada, *Radioisotopes, *Radioactive dating, *Confined aquifers, Groundwater movement, Aquitards, Hydraulic conductivity, Groundwater recharge, Chemical properties.

The Milk River artesian aquifer underlies 15,000 sq km of southern Alberta, Canada. It consists of thin (30-75 m thick) sandstone and is confined above by the Pakowki shale (typically 120 m thick) and below by the Colorado shale. The aquifer subcrops in southern Alberta and northern Montana. Groundwater movement is to the north, west, and east from the outcrop area (dominant recharge area). Cl(-) and I(-) concentrations increase in the direction of flow from less than 0.05 and 0.001 mmol/l, respectively, near the recharge area to more than 140 and 0.15 mmol/l at the northern edge of the aquifer. Similarly, waters become more enriched in Oxygen-18 and deuterium from less than -21.0 and -16.7o/oo near the recharge area to values approaching -8.0 and -70.0o/oo in the north. Isotope values in the recharge area plot on the global meteoric water line and indicate that the recharge waters are isotopically unaltered meteoric waters. Downgradient from the recharge area the data deviate from the meteoric water line (slope 6.3 instead of 8.0). Three mechanisms have been advanced to explain the origin of the chemical and isotopic patterns: the introduction of connate formation water through the Colorado shale and subsequent mixing with infiltrating meteoric water; a finite source of meteoric recharge mixing with more saline water in the aquifer; and chemical and isotopic enrichment due to ion filtration. Hydraulic conductivity and hydraulic head data, Cl(-) concentrations of drill cuttings and isotopic values from groundwater from the Colorado shale provide arguments for reevaluating these ideas. An alternative mechanism, based on diffusion between saline, isotopically enriched water in the Colorado shale and fresher, isotopically depleted water in the aquifer, is tested using an analytical mass transport model. Although uncertainty exists in the model parameters, results showed that the patterns in Cl(-), I(-), delta-oxygen-18, and delta-H-2 in the aquifer can be explained by aquitard diffusion. Further, aquitard diffusion must be considered when using Chlorine-36 dating methods in aquifer-aquitard systems such as the Milk River aquifer. (Author's abstract)
W89-03813

COUPLED GROUNDWATER FLOW AND SOLUTE TRANSPORT WITH FLUID DENSITY STRONGLY DEPENDENT UPON CONCENTRATION,
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
A. W. Herbert, C. P. Jackson, and D. A. Lever.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1781-1795, October 1988. 13 fig, 1 tab, 16 ref.

Descriptors: *Path of pollutants, *Radioactive waste disposal, *Model studies, *Groundwater pollution, *Groundwater movement, *Solute transport, Mathematical models, Porous media, Density, Brines, Waste disposal.

The governing equations are discussed for the flow of salt solution with significant density variations through a porous medium. Equations for mass conservation, salt conservation, and momentum conservation are formulated in terms of the mass fraction weighted average velocity and the mass fraction of concentrated salt solution, and the underlying approximations are considered. these equations are incorporated in the finite element groundwater code NAMMU and applied to test case 5 of level 1 of the international HYDROCOIN project. This test case proposed to model the groundwater flow over a hypothetical salt dome. The nonlinearities arising from the density

variation and from a velocity-dependent dispersion tensor made the problem very hard: special techniques had to be used, including mixed interpolation finite elements and parameter stepping. A series of solutions at successfully smaller values of dispersion were obtained starting from a related problem involving a large diffusivity. The final solution is to a physically realistically problem very similar to that specified. General conclusions are drawn relevant to modeling these flow and the numerical code is used with confidence. (Author's abstract)
W89-03815

GENERALIZED RADIAL FLOW MODEL FOR HYDRAULIC TESTS IN FRACTURED ROCK,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 7B.
W89-03816

DAGAN MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: APPLICATION TO THE BORDEN SITE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-03817

STABLE-ISOTOPE GEOCHEMISTRY OF SALINE NEAR-SURFACE GROUND WATER: EAST-CENTRAL MICHIGAN BASIN,
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W89-03906

NEW CONTINUOUS-SAMPLING WIRELINE SYSTEM FOR ACQUISITION OF UNCONTAMINATED, MINIMALLY DISTURBED SOIL SAMPLES,
For primary bibliographic entry see Field 7B.
W89-03920

MIGRATION OF PETROLEUM PRODUCTS THROUGH SANDY HYDROGEOLOGIC SYSTEMS,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W89-03921

GENERALIZED GROUND WATER SAMPLING DEVICE MATRIX,
Nevada Univ. System, Las Vegas. Water Resources Center.
For primary bibliographic entry see Field 7B.
W89-03922

RECONNAISSANCE ISOTOPE STUDY OF WATERS IN THE KARST OF THE WESTERN TATRA MOUNTAINS,
Institute of Physics and Nuclear Techniques, Krakow (Poland).
K. Rozanski, and J. Dulinski.
Catena, Vol. 15, No. 3-4, p 289-301, June-August 1988. 5 fig, 2 tab, 22 ref.

Descriptors: *Karst hydrology, *Isotopic tracers, *Tracers movement, *Precipitation, *Isotope studies, *Mountains, *Groundwater, Deuterium, Seasonal variation, Oxygen, Surface water, Seepage.

Results of isotope investigations of waters collected in the karstic areas of the Western Tatra Mountains, are presented. Altogether 35 groundwater samples have been analyzed. They represent grondwaters collected on the earth surface as well as waters found in caves. Parallel, systematic isotope analyses of monthly precipitation collected at the Ornak station located in the center of the investigated area were also carried out. The results of isotope investigations fully confirm earlier suggestions that the karst system of the Western Tatra Mountains consists of separate independent subsystems exhibiting weak hydraulic interconnections. Tritium data allow a semi-quantitative assessment of the mean residence time of the baseflow component in the investigated system. It is equal to at least 7/8 years. Eventual further measurements of tritium content should allow a more precise determination of this parameter. It appears that groundwaters collected in caves exhibit on the average significantly higher D and 18 O content compared to groundwaters collected on the surface. Possible reasons of this effect are discussed in this paper. (Author's abstract)
W89-03974

PROCEDURE OF CODING HYDROCHEMICAL DATA FOR CORRESPONDENCE FACTOR ANALYSIS: APPLICATION TO THE CHARACTERIZATION OF GROUNDWATER FLOWS IN MULTI-RESERVOIR SYSTEMS (METHODE D'ADAPTATION DES DONNEES HYDROGEOCHIMIQUES EN ANALYSE DES CORRESPONDANCES: APPLICATION A LA CARACTERISATION DES CIRCULATIONS DANS LES SYSTEMES HYDROGEOLOGIQUES MULTI-RESERVOIRS),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
M. Razack, and J. Dazy.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 307, No. 6, p 669-675, July 30, 1988. 5 fig, 7 ref. English summary.

Descriptors: *Water chemistry, *Tracers, *Groundwater movement, *Geohydrology, *Thermal springs, Chemical properties, Springs, Chlorides, Bicarbonates, Calcium, Sodium, Sulfates, Alpine regions.

A procedure for coding hydrochemical data with the use of Piper's principle is proposed to adjust the data to the correspondence factor analysis. This approach is applied to characterize the various components of complex mixtures of groundwater flows of different origin (deep, subsurface, and superficial reservoirs). Flows originating at greater depth were found to be characterized by high sodium content, while flows with superficial or subsurface origins are characterized by high sulfate content. Additional work using this procedure is in progress, including studies of other alpine hydrothermal systems in the French Alps. (Doria-PTT)
W89-03987

CHEMICAL AND HYDROLOGIC DATA FOR SELECTED THERMAL-WATER WELLS AND NONTHERMAL SPRINGS IN THE BOISE AREA, SOUTHWESTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04028

PROGRESS REPORT ON THE GROUNDWATER, SURFACE WATER, AND QUALITY-OF-WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA-1987-88,
Geological Survey, Flagstaff, AZ. Water Resources Div.
R. J. Hart, and J. P. Sottilare.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $5.00, microfiche $4.00. USGS Open-File Report 88-467, August 1988. 27p, 6 fig, 9 tab, 8 ref.

Descriptors: *Groundwater resources, *Withdrawal, *Drawdown, *Arizona, *Water level, *Water quality, Northeastern Arizona, Black Mesa, Navajo Indian Reservation, Hopi Indian Reservation, N aquifer.

The Black Mesa, Arizona, monitoring program is designed to determine long-term effects on the water resources of the area resulting from withdrawals of groundwater from the N aquifer by the strip-mining operation of Peabody Coal Company. Withdrawals by Peabody Coal Company increased from 95 acre-ft in 1968 to 3,832 acre-ft in 1987. The N aquifer is an important source of water in the 5,400-sq-mi Black Mesa area on the Navajo and Hopi Indian Reservations. Water levels in the confined area of the aquifer declined as much as 95.1 ft near Keams Canyon from 1965 to 1988. Part of the decline in the measured municipal wells may be due to local pumping. During 1965-88, water levels in wells that tap the unconfined area of the aquifer have not declined significantly and have risen in many areas. Chemical analyses indicate no significant changes in the quality of water from wells that tap the N aquifer or from springs that discharge from several stratigraphic units, including the N aquifer, since pumping began at the mine. (USGS)
W89-04029

JANUARY 1988 WATER LEVELS, AND DATA RELATED TO WATER LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
B. J. Pabst.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $24.50, microfiche $4.00. USGS Open-File Report 88-342, 1988. 158p, 2 fig, 1 tab, 19 ref.

Descriptors: *Groundwater, *Water level changes, *Hydrologic data, *Kansas, High Plains aquifer.

Hydrologic data related to water level measurements made in observation wells in western and south-central Kansas are listed. The measurements were made in midwinter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water level changes from a 'base year' (predevelopment), a reference year of abnormally large amounts of rainfall and minimum pumpage (1966 or 1974), and each of 7 consecutive years of measurement (1982-88). The 'base year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern, west central, and Equus beds areas. Data also are provided for relating the mean annual water level changes, saturated thicknesses of the water-bearing deposits, and percentage changes in saturated thickness. Groundwater levels measured in about 1,360 wells completed in the High Plains aquifer of western and south-central Kansas had a mean net decline of 0.1 ft during 1987 compared to a 0.6 ft mean decline during 1986. (USGS)
W89-04031

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1987,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04036

MAP SHOWING DEPTH TO BEDROCK, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04037

APPROXIMATE CHANGE IN WATER LEVELS IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-88 AND 1987-88, AND MEASURED COMPACTION, 1973-88, IN THE HOUSTON-GALVESTON REGION, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04040

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN ILLINOIS, 1987,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04044

SUMMARY OF WATER RESOURCES DATA FOR THE GIRDWOOD-ALYESKA AREA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04046

DOCUMENTATION OF A STEADY-STATE SALTWATER-INTRUSION MODEL FOR THREE-DIMENSIONAL GROUNDWATER FLOW, AND USER'S GUIDE,
Geological Survey, Tacoma, WA. Water Resources Div.
D. B. Sapik.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-526, 1988. 174p, 7 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Computer models, *Saline-freshwater interfaces, *Saline water intrusion, Simulation, Steady flow, Coastal aquifers, Groundwater movement.

A finite-difference model that simulates three-dimensional flow of groundwater was modified to simulate steady flow of freshwater in a multiple-aquifer system containing freshwater and static saltwater. The two fluids are assumed to be immiscible, with constant but different densities, and are separated by a sharp interface. The interface position computed by the model for a test problem was in good agreement with the analytic solution for this problem. The model was developed to simulate seawater intrusion in coastal aquifers, but it could be used to simulate flow in any aquifer system that is bounded by saltwater. This report describes modifications made to the existing numerical model and the method of locating an interface, and contains a user's guide for the model. (USGS)
W89-04048

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1987,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04049

GROUNDWATER LEVELS IN ARKANSAS, SPRING 1987,
Geological Survey, Little Rock, AR. Water Resources Div.
D. A. Freiwald, and M. Plafcan.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-459, 1987. 66p, 5 fig, 16 tab, 29 ref.

Descriptors: *Groundwater level, *Observation wells, *Arkansas, Monitoring, Aquifers, Well hydrographs, Alluvial aquifers, Sparta Sand.

Groundwater level measurements were made in 701 observation wells in Arkansas in the spring of 1987. This report contains the water level data presented in tables listed by aquifer; then by county. For each well, the depth to water below land surface and the altitude of the water level for 1987 are shown, along with the net change in water level between 1986 and 1987 and between 1982 and 1987. In addition, the report contains maps showing the average water level changes, by county, between the years 1982 and 1987 for the aquifers in the Quaternary deposits and the Sparta and Memphis Sands. Also shown are water level hydrographs for selected wells completed in the Quarternary deposits and Sparta Sand. The aquifers in the Quarternary deposits and the Sparta and Memphis Sands are important aquifers in eastern and southern Arkansas for agricultural, municipal, and industrial use. Water level data showed an average water level decline of 0.03 ft in the Quaternary deposits of the 24 most heavily irrigated counties of eastern Arkansas and 0.39 ft in the Sparta and Memphis Sands between the years 1982 and 1987. (USGS)
W89-04051

PROGRESS REPORT ON THE GROUNDWATER, SURFACE WATER, AND QUALITY-OF-WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA - 1987,
Geological Survey, Flagstaff, AZ. Water Resources Div.
G. W. Hill, and J. P. Sottilare.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-458, 1987. 29p, 4 fig, 9 tab, 8 ref.

Descriptors: *Groundwater, *Groundwater quality, *Drawdown, *Water quality, *Arizona, *Monitoring, Black Mesa, Navajo Indian Reservation, Hopi Indian Reservation.

The N aquifer is an important source of water in the 5,400 sq-mi Black Mesa area on the Navajo and Hopi Indian Reservations. The Black Mesa monitoring program is designed to monitor long-term effects on the groundwater resources of the mesa as a result of withdrawals from the aquifer by the strip-mining operation of Peabody Coal Company. Withdrawals from the N aquifer by the mine increased from 95 acre-ft in 1968 to more than 4,480 acre-ft in 1986. Water levels in the confined area of the aquifer declined as much as 90 ft from 1965 to 1987 in some municipal and observation wells within about a 15-mi radius of the mine well field. Part of the drawdown in municipal wells is due to local pumpage. Water levels have not declined in wells tapping the unconfined area of the aquifer. Chemical analyses indicate no significant changes in the quality of water from wells that tap the N aquifer or from springs that discharge from several stratigraphic units, including the N aquifer, since pumping began at the mine. (USGS)
W89-04052

EXPLORATION FOR AREAS SUITABLE FOR GROUNDWATER DEVELOPMENT, CENTRAL CONNECTICUT VALLEY LOWLANDS, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
B. P. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4106. 51p, 8 ilus, 3 tab, 13 ref, 1 plate.

Descriptors: *Groundwater availability, *Glacial aquifers, *Radioactive well logging, *Massachusetts, Test holes, Electrical well logging, Seismology, Connecticut River valley lowlands, Lacustrine deposits, Seismic refraction, Seismic marine reflection, Gamma logging.

Drilling and geophysical borehole logs for a 25-sq-mi section of the Connecticut River valley lowlands area of Amherst, Hadley, and Sunderland, Massachusetts, indicate that the area is mostly underlain by fine-grained lacustrine deposits. Nine test wells ranging in depth from 100 to 303 ft completely penetrate the unconsolidated valley fill. Geophysical logs indicate that the lacustrine deposits grade from clay to slightly coarser silt or fine sand with increasing depth. Seismic-refraction surveys indicate bedrock surfaces ranging from 138 to 476 ft below land surface. Interpretation of a continuous seismic-reflection profile on 10.8 mi of the Connecticut River indicates some areas where coarse deposits may underlie the fine-grained lake deposits. These deposits appear to range in thickness from 0 to 165 ft. Bedrock surfaces with elevations down to 190 ft below sea level also were indicated. Water is presently being withdrawn from limited and irregularly distributed sand and gravel deposits for municipal supplies. These deposits may be continuous with previously mapped surficial ice-contact sand and gravel deposits. Areas that are most favorable for future groundwater exploration are mainly in the southern part of the area, between the Connecticut River and the Holyoke Range. (USGS)
W89-04054

PRELIMINARY DATA FOR NORTHERN GREAT PLAINS TEST WELL 1, NW 1/4 NE 1/4 SEC. 11, T.55N., R.77W., SHERIDAN COUNTY, WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
D. H. Lobmeyer, L. O. Anna, and J. F. Busby.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-446, 1982. 80p, 22 fig, 19 tab, 10 ref.

Descriptors: *Wyoming, *Groundwater data, *Hydrologic data, *Water quality, Water levels, Hydrologic properties, Geologic formations, Sheridan County, Wyoming, Powder River Basin, Geophysical logs, Cores.

This report documents the preliminary data obtained from Northern Great Plains test well 1 and describes the preliminary results and future testing plans. The intended audience includes hydrologists, local water users, drilling contractors, and water managers. The test well was drilled as part of the study to determine the water resource potential of the regional aquifer system in the Northern Great Plains, an area of about 250,000 sq mi. The well is 4,485 ft deep; nine cores were drilled totaling 182 ft; 157.42 ft of core were recovered. Sidewall cores were obtained from 24 horizons. Gamma and density scans of the cores were made, and selected parts were tested for density, porosity, and vertical and horizontal permeability. Eight zones were perforated and tested using conventional drill-stem tests and swabbing. Water samples were obtained from seven zones. No major potential sources of groundwater were penetrated by the test well. Estimated yields from selected zones range from about 240 gal/min with 400 ft of drawdown to about 5 gal/min flow at the surface. Dissolved-solids concentrations ranged from about 1,800 to 3,000 mg/l. (USGS)
W89-04055

APPROXIMATE CHANGE IN WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-87 AND 1986-87, AND MEASURED COMPACTION, 1973-87, IN THE HOUSTON-GALVESTON REGION, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04057

DESCRIPTION AND RESULTS OF TEST-DRILLING PROGRAM AT PICATINNY ARSENAL, NEW JERSEY, 1982-1984,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04060

HYDROLOGY OF AREA 41, WESTERN REGION, INTERIOR COAL PROVINCE, OKLAHOMA AND ARKANSAS,
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, D. L. Bergman, L. J. Slack, S. P. Blumer, and R. L. Goemaat.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Open-File Report 84-129, 1987. 86p, 58 fig, 13 tab, 80 ref.

Descriptors: *Coal mining impact, *Groundwater, *Water quality data, *Oklahoma, *Arkansas, Hydrology, Arkansas River, Canadian River, Geohydrology, Poteau River, Muddy Boggy Creek, Clear Boggy Creek.

Coal Area 41 in the Western Region, Interior Coal Province, includes about 11,500 sq mi in eastern Oklahoma and western Arkansas. Rocks of Pennsylvania age underlie about 95% of the area and contain approximately 8.2 billion tons of remaining coal reserves. About 80% of the area is drained by the Arkansas River; the remainder is drained by the Red River. Streamflow data have been collected systemically at 118 stations. At least four determinations of specific conductance and pH have been made at 95 stream stations. Water level data are available for nearly 1,700 wells and chemical-quality data are available for water from about

1,400 wells. Maps, graphs, diagrams, and tables, accompanied by a short explanatory text, are used to summarize the hydrology of the area including actual or potential effects of surface mining coal. In addition, the report includes sections on geology, soils, land use, climate, water use, and water data sources. This information will be of use to mine operators, consulting engineers, regulatory agencies, and other concerned with the hydrologic effects of coal mining in the area. (USGS)
W89-04070

GROUNDWATER LEVEL DATA FOR THE ALBUQUERQUE-BELEN BASIN, NEW MEXICO THROUGH WATER YEAR 1985,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04071

GROUNDWATER AVAILABILITY IN THE EASTERN PART OF THE LAKE ONTARIO BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04074

GEOHYDROLOGIC DATA FROM PORT ROYAL SOUND, BEAUFORT COUNTY, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
R. A. Burt, D. L. Belval, M. Crouch, and W. B. Hughes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-497, 1987. 67p, 19 fig, 10 tab, 32 ref, 9 plates.

Descriptors: *Geohydrology, *Water quality, *Hydrologic data collections, *South Carolina, *Aquifers, Water levels, Floridan aquifer.

Nine offshore wells were drilled through overlying sediments into the Upper Floridan aquifer in Port Royal Sound, South Carolina and the adjacent Atlantic Ocean, to obtain geologic, hydrologic, and water quality data. The Upper Floridan aquifer consists predominantly of light-gray, poorly consolidated, fossiliferous limestone. In the Port Royal Sound area, the Upper Floridan is overlain by olive-gray, medium to course sand and silty sand. Falling-head permeability tests on these overlying clastic sediments indicate permeabilities of 1,100 to 4.3 x 10 to the 7th power centimeters/sec. Other geologic and hydrologic data, including geophysical logs, sieve analyses, and detailed core descriptions were obtained, along with continuous water level records of the wells, tidal records, and barometric pressure records. Water collected from the Upper Floridan aquifer beneath Port Royal Sound and the ocean ranged in concentration of chloride from 54 to 12,000 mg/l. Measured pH ranged from 6.8 to 8.4, and alkalinity ranged from 122 to 368 mg/l as CaC03. Other water quality data obtained include temperature, specific conductance, carbon-13, carbon-14, tritium, deuterium, oxygen-18, dissolved oxygen, dissolved solids, nitrogen species, phosphorus, organic carbon, cyanide, sulfide, calcium, magnesium, sodium, potassium, sulfate, fluoride, silica, bromide, iodide, and selected trace metals. (USGS)
W89-04075

BEDROCK AQUIFERS IN THE DENVER BASIN, COLORADO - A QUANTITATIVE WATER RESOURCES APPRAISAL,
Geological Survey, Lakewood, CO. Water Resources Div.
S. G. Robson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Professional Paper 1257, 1987. 73p, 37 fig, 10 tab, 41 ref, 37 plates.

Descriptors: *Groundwater, *Geohydrology, *Colorado, *Denver Basin, Aquifer systems, Model studies, Water resources development, Dawson Arkose, Denver Formation, Araphahoe Formation, Laramie Formation, Fox Hills Sandstone.

Groundwater modeling techniques were used to simulate aquifer response to various pumpage estimates and groundwater development plans. It is estimated that 270 million acre-ft of recoverable groundwater is in storage in four bedrock aquifers. However, less than 0.1% of this volume of water is stored under confined conditions. The larger volume of water stored under unconfined conditions will be available for use only when the water levels in the confined aquifers decline below the top of the individual aquifer, allowing water table conditions to develop. Annual precipitation on the Denver Basin supplies an average of 6,900 CFS of water to the area; about 55 CFS of this recharges the bedrock aquifers. Pumpage exceeds recharge in the metropolitan area and has caused water level declines (1958-78) to exceed 200 ft southeast of Denver. A quasi-three-dimensional finite-difference model of the aquifer system was constructed and calibrated under steady-state and transient-state conditions. Steady-state calibration indicated that lateral hydraulic conductivity within the aquifers is about 100,000 times larger than vertical hydraulic conductivity between the aquifers. Transient-state calibration indicated that between 1958 and 1978, 374,000 acre-ft of water was pumped from the aquifers, producing a 90,000-acre-ft net decrease in the volume of water in storage in the aquifers. During this time, pumpage also changed the rates of interaquifer flow, induced additional recharge, and cause capture of natural discharge. Three 1979-2050 pumpage estimates were made for use in simulating the effects of various groundwater development plans. Simulations, using each of these pumpage estimates, indicated that by the yr 2050, large water level declines could occur, particularly in the deeper aquifers. Maximum water level declines of 410, 1,700, and 1,830 ft were produced, using the small, medium, and large pumping rates. Four plans for supplementing the Denver water supply include pumping a satellite well field, pumping a municipal well field, pumping to irrigate parks, and injecting water during periods of low demand for later use during periods of peak demand. Model simulation of these plans indicated that the satellite well field will yield twice as much water as the municipal well field but will produce larger and more widespread water level declines in the four aquifers. (USGS)
W89-04076

SELECTED GROUNDWATER DATA IN THE UPPER MONGAUP RIVER BASIN, SULLIVAN COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04077

HYDROLOGY OF AREA 28, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04079

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1986,
Geological Survey, Jacksonville, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04080

GEOLOGIC RECONNAISSANCE OF AN EXTENSIVE CLAY UNIT IN NORTH-CENTRAL SUFFOLK COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
R. K. Krulikas, and E. J. Koszalka.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 82-4075, 1983. 9p, 5 fig, 1 plate, 10 ref.

Descriptors: *Aquifers, *New York, *Groundwater, *Aquicludes, *Clays, *Geohydrology, Stratigraphy, Long Island, Suffolk County.

Recent geologic data indicate an extensive lacustrine clay unit within the glacial deposits in the area between the Harbor Hill and Ronkonkoma moraines in north-central Suffolk County, New York. The unit, locally known as the 'Smithtown clay unit' (informal usage), is an integral part of the glacial aquifer in this area. The clay occurs at depths varying from 90 ft above to 150 ft below National Geodetic Vertical Datum of 1929 (NGVD) and attains a maximum thickness of 170 ft in the northern part of the Town of Smithtown. Its upper surface is mostly above NGVD and reaches a maximum altitude of 90 ft in the Town of Huntington. The unit is predominantly clay but locally contains lenses of sand, silt, and gravel. The upper part of the clay is generally light to dark brown; the lower part is light gray, which is characteristics of other clays in the glacial aquifer. (USGS)
W89-04082

PUMPAGE DATA FROM PUBLIC-SUPPLY WELLS AT ANCHORAGE, ALASKA, 1957-85.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04085

GROUNDWATER LEVELS IN THE CARBONATE ROCKS OF CENTRAL CHESTER COUNTY, PENNSYLVANIA, MAY 18 TO JUNE 15, 1984,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04086

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1965,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04088

RECORDS OF WELLS AND CHEMICAL ANALYSES OF GROUNDWATER IN CAMPBELL COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
K. M. Neitzert, and N. C. Koch.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-42, 1987. 35p, 2 fig, 2 tab.

Descriptors: *Well data, *Water analysis, *Water quality, *South Dakota, *Water resources data.

Well and chemical groundwater data contained in two tables were collected during a 3-yr study started in 1964 to determine the geology and water resources of Campbell County, South Dakota. Physical, hydrologic, and geologic data for 631 wells and test holes have been entered into computer storage in the Groundwater Site Inventory File of the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE). The well table in the report is a computer printout from WATSTORE. Water quality data from 257 chemical analyses have been stored in the Water Quality File of WATSTORE and is computer printed in the chemical table by aquifer. (USGS)
W89-04089

SELECTED HYDROLOGIC DATA FOR SALT LAKE VALLEY, UTAH, OCTOBER 1968 TO OCTOBER 1985,
Geological Survey, Salt Lake City, UT. Water Resources Div.

R. L. Seiler.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-249, 1986. 57p, 2 fig, 4 tab, 8 ref.

Descriptors: *Utah, *Groundwater data, *Water quality data, *Water levels, *Hydrologic data, *Data collections, Water wells, Water quality.

This report presents hydrologic data for 281 wells in the Salt Lake Valley, Utah. Most of the data were collected from October 1968 to October 1985 by the U.S. Geological Survey, but the report also includes some data that were published in previous reports. Data presented include records of wells, water levels, and chemical analyses for selected wells. (USGS)
W89-04093

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1983,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04094

RECONNAISSANCE WATER QUALITY APPRAISAL OF THE FOUNTAIN CREEK ALLUVIAL AQUIFER BETWEEN COLORADO SPRINGS AND PUEBLO, COLORADO, INCLUDING TRACE ELEMENTS AND ORGANIC CONSTITUENTS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04104

EFFECT OF REDUCED INDUSTRIAL PUMPAGE ON THE MIGRATION OF DISSOLVED NITROGEN IN AN OUTWASH AQUIFER AT OLEAN, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04106

HYDROGEOLOGY OF THE VALLEY-FILL AQUIFERS, SALAMANCA AREA, CATTARAGUS COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04109

HYDROGEOLOGY OF THE CAMBRIAN-ORDOVICIAN AQUIFER SYSTEM AT A TEST WELL IN NORTHEASTERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
J. R. Nicholas, M. G. Sherrill, and H. L. Young.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4165, 1987. 30p, 19 fig, 5 tab, 20 ref.

Descriptors: *Groundwater, *Test wells, *Aquifer testing, *Borehole geophysics, *Confining beds, *Illinois, Water quality, Aquifer systems, Precambrian rock, Piezometers, Geohydrology.

A 3,475-ft-deep test well was drilled in northeastern Illinois near Lake Michigan and the Illinois-Wisconsin State line as part of a regional hydrologic study of the Cambrian-Ordovician aquifer. The well penetrates the Cambrian-Ordovician aquifer system and 40 ft of Precambrian granite. From oldest to youngest the aquifer system consists of the lower Mount Simon aquifer, Mount Simon confining unit, Elmhurst-Mount Simon aquifer, Eau Claire confining unit, Ironton-Galesville aquifer, Franconia confining unit, St. Peter aquifer, and an upper confining unit composed of the Glenwood Formation, Galena Dolomite and Platteville Limestone, and Maquoketa Shale. Aquifer tests were performed on hydrogeologic units that were isolated with inflatable packers. Results indicate that the Ironton-Galesville aquifer has the highest hydraulic conductivity - 10 ft/day. The St. Peter and Elmhurst-Mount Simon aquifers have hydraulic conductivities of 1.8 and 1.5 ft/day, respectively. The Mount Simon confining bed has a hydraulic conductivity of 1.3 ft/day. The Mount Simon confining unit confines saline water present in the lower Mount Simon aquifer. The dissolved solids concentration in water from this aquifer is > than 55,000 mg/L, and the head is at least 50 ft higher than heads in any of the overlying Cambrian and Ordovician aquifers. (USGS)
W89-04110

DOCUMENTATION OF COMPUTER PROGRAM VS2D TO SOLVE THE EQUATIONS OF FLUID FLOW IN VARIABLY SATURATED POROUS MEDIA,
Geological Survey, Lakewood, CO. Water Resources Div.
E. G. Lappala, R. W. Healy, and E. P. Weeks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 83-4099, 1987. 184p, 27 fig, 15 tab, 51 ref.

Descriptors: *Unsaturated flow, *Computer models, *Computer programs, *Infiltration, Recharge, Evapotranspiration, Moisture tension, Aeration zone.

This report documents FORTRAN computer code for solving problems involving variably saturated single-phase flow in porous media. The flow equation is written with total hydraulic potential as the dependent variable, which allows straightforward treatment of both saturated and unsaturated conditions. The spatial derivatives in the flow equation are approximated by central differences, and time derivatives are approximated either by a fully implicit backward or by a centered-difference scheme. Nonlinear conductance and storage terms may be linearized using either an explicit method or an implicit Newton-Raphson method. Relative hydraulic conductivity is evaluated at cell boundaries by using either full upstream weighting, the arithmetic mean, or the geometric mean of values from adjacent cells. Nonlinear boundary conditions treated by the code include infiltration, evaporation, and seepage faces. Extraction by plant roots that is caused by atmospheric demand is included as a nonlinear sink term. These nonlinear boundary and sink terms are linearized implicitly. The code has been verified for several one-dimensional linear problems for which analytical solutions exist and against two nonlinear problems that have been simulated with other numerical models. A complete listing of data-entry requirements and data entry and results for three example problems are provided. (USGS)
W89-04111

HYDROLOGY OF AREA 46, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES; NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04112

GEOHYDROLOGY AND GROUNDWATER QUALITY MONITORING NETWORK FOR THE ANTELOPE VALLEY AREA, CALIFORNIA,
Geological Survey, Tahoe City, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-04114

HYDROLOGIC RECONNAISSANCE OF THE CHILKAT RIVER BASIN, SOUTHEAST ALASKA (WITH SPECIAL REFERENCE TO THE ALASKA CHILKAT BALD EAGLE PRESERVE),
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-04116

GEOHYDROLOGIC FRAMEWORK OF THE SOUTHWEST ALLUVIAL BASINS, REGIONAL AQUIFER-SYSTEMS ANALYSIS, PARTS OF COLORADO, NEW MEXICO AND TEXAS,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Wilkins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4224, 1986. 61p, 9 fig, 7 pl, 145 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater, *Colorado, *New Mexico, *Texas, Groundwater basins, Potentiometric level, Water quality, River basins, Closed basins, Aquifer-system analysis, Rio Grande rift.

The Southwest Alluvial Basins study is part of the National Regional Aquifer-Systems Analysis program. Twenty-two structural basins extend from the San Luis Basin in southern Colorado to the Presidio Basin in western Texas. Closed surface-water basins west of the Guadalupe Mountains and east of the Peloncillo Mountains are included in the study. The study area is bounded on the east by predominately Precambrian and Paleozoic rocks. Tertiary and Quaternary volcanics also are present. Tertiary and Quaternary volcanic rocks, and also Mesozoic rocks west of the Espanola and Albuquerque-Belen Basins, form the west boundary. The east and west boundary units converge at the north end of the study area to form the north boundary. The study area extends south to the international border between the United States and Mexico. The Santa Fe Group sediments of late Oligocene to middle Pleistocene age comprise the main aquifer in the area. Estimated maximum depths of sediments in the rift basins range from 8,000 ft in the Tularosa-Hueco Basin to 30,000 ft in the San Luis Basin. The average thickness of sediments in closed basins is about 4,000 ft. Santa Fe deposits are composed of layers of gravel, sand, silt, and clay interbedded with local volcanic lows of tuffs. Lacustrine deposits are more prevalent in the closed basins. Wells produce as much as 2,000 gal of water/min. Poteniometric-surface altitudes for 1971-82 indicate that water recharges in the highland areas around the basins and discharges in the center of valleys. Water generally flows from the east and west southward along the axis of the valleys. Groundwater quality for the region has been zoned into calcium sulfate, calcium chloride, magnesium sulfate, magnesium chloride; sodium sulfate, sodium chloride; sodium bicarbonate; and calcium bicarbonate, magnesium bicarbonate types. (USGS)
W89-04121

HYDROGEOLOGIC DATA FROM A STUDY OF THE FRESHWATER ZONE/SALINE WATER ZONE INTERFACE IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04123

SUMMARY OF WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN COLORADO, FY 1987,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04124

HYDROLOGY OF THE LOWER LITTLE RED RIVER, ARKANSAS, AND A PROCEDURE FOR ESTIMATING AVAILABLE STREAMFLOW,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04125

WATER LEVELS, CHLORIDE CONCENTRATIONS, AND PUMPAGE IN THE COASTAL

AQUIFERS OF DELAWARE AND MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
D. J. Phelan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4229, 1987. 106p, 59 fig, 10 tab, 36 ref, append.

Descriptors: *Chlorides, *Pumping, *Delaware, *Maryland, *Saline water intrusion, *Drawdown, Sussex County, Worcester County, Water quality, Aquifers, Seasonal pumping, Surface groundwater relations, Water levels.

The Manokin, Ocean City, Pocomoke, and unconfined aquifers of coastal Delaware and Maryland are susceptible to saltwater intrusion from inland movement of offshore water, and from vertical leakage from the bays and deeper aquifer. Comparison of data for water levels, chloride, and pumpage affected during 1974-86 shows that, with the exception of the 44th Street area in Ocean City, Maryland, increased pumpage and lower water levels have not yet caused corresponding increases in chloride concentrations in the confined aquifers. Pumpage from shallow wells near the inland bays has caused localized saltwater intrusion into the unconfined aquifer. Chloride concentrations in the Ocean City aquifer at 44th Street increased from 50 to 200mg/L from 1976 to 1986. Chloride concentrations in water from wells in the Manokin aquifer ranged from 6 to 460 mg/L, whereas those in the Ocean City aquifer ranged from 6 to 260 mg/L. Chloride concentrations in water from the Pocomoke aquifer ranged from 5 to 46 mg/L, and from 11.5 to 46 mg/L in the unconfined aquifer. Seasonal high water levels are affected more by total annual rainfall than by pumpage. Seasonal low water levels generally have declined during most years in areas of heavy pumpage along the coast. Inland, water levels have remained about the same of year to year. (USGS)
W89-04126

MULTI-GRID MODEL FOR STEADY FLOW IN A PARTIALLY SATURATED POROUS MEDIUM,
Washington Univ., Seattle. Dept. of Civil Engineering.
T. J. McKeon, and W. Chu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB89-102230. Price codes: A06 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Project Completion Report. April 1986. 93p, 13 fig, 7 tab, 56 ref, 2 append. Contract No. 14-08-0001-G1051. Project No. USGS G1051-06.

Descriptors: *Computer models, *Steady flow, *Unsaturated flow, *Porous medium, Model studies, Algorithm, Multi-grid model, Simulation analysis, Equations.

A numerical model for steady flow in a partially saturated porous medium uses the multi-grid solution algorithm for solving the system of equations resulting from the discrete approximation to the partial differential equation. The multi-grid method is very efficient for problems with a number of unknowns on the order of ten thousand or more. The model was applied to a highly nonlinear partially saturated flow problem and the solution algorithm still showed very fast convergence. The model can be used to simulate reasonable large scale problems with a very fine grid resolution. (USGS)
W89-04129

GROUNDWATER DATA FOR GEORGIA, 1986,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, S. A. Longsworth, C. N. Joiner, M. F. Peck, and K. W. McFadden.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-376, 1987. 177p, 84 fig, 51 ref.

Descriptors: *Hydrologic data collections, *Groundwater, *Water levels, *Georgia, *Water quality, Data collections, Aquifers.

Continuous water level records from 152 wells and water level measurements from an additional 750 wells in Georgia during 1986 provide the basic data for this report. Hydrographs for selected wells illustrate the effects that changes in recharge and discharge have had on the groundwater reservoirs in the State. Daily mean water levels are shown in hydrographs for 1986. Monthly mean water levels are shown for the 10-yr period 1977-86. During 1986, a prolonged drought resulted in water level declines throughout the State. Annual mean water levels were from 2.7 ft higher to 17.3 ft lower than in 1985, and record lows were measured in 33 wells in the summer and fall. The 1986 lows were from 0.02 ft to 29.2 ft lower than the previous record lows. The largest declines were measured in the Clayton aquifer in the southwestern part of the State. The declines can be attributed to reduced recharge and increased pumping that resulted from below-normal precipitation during the first half of the year. Water quality samples are collected periodically throughout Georgia and analyzed as part of areal and regional groundwater studies. Periodic monitoring of water quality in the Savannah and Brunswick areas indicates that the chloride concentration in the Upper Floridan aquifer there generally has remained stable. (USGS)
W89-04132

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1987,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04138

GROUNDWATER LEVELS IN ALASKA, WATER YEAR 1984,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04140

WATER RESOURCES ACTIVITIES IN ILLINOIS, 1986,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04149

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY MID-ATLANTIC DISTRICT 1984-1986,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04155

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN THE TUCSON BASIN, PIMA COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04156

GROUNDWATER DATA FOR WEST VIRGINIA, 1974-84,
Geological Survey, Morgantown, WV. Water Resources Div.
F. M. Taylor, and M. T. Roiser.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-320, 1986. 66p, 26 fig, 4 ref.

Descriptors: *Groundwater data, *West Virginia, *Water level fluctuations, *Water quality, *Well hydrographs, *Observation wells, Water table wells, Artesian wells.

Groundwater investigations began in West Virginia in 1941. As an aid to development and management of the State's water resources, the U.S. Geological Survey, in cooperation with the West Virginia Geological and Economic Survey, maintains a network of 31 observation wells throughout the State. Some wells are equipped with continuous water level recorders, and some are measured manually on a daily, weekly, monthly, or semiannual basis. This report presents the water level data that were collected from 1974-83 at 31 observation wells. Chemical data were collected for 17 of these wells, primarily in 1984. This report presents a map showing locations of the observation wells, a description of each well and supplementary information, 1-yr and 10-yr hydrographs, and tables of chemical data. (USGS)
W89-04157

HYDROLOGY OF AREA 50, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, WYOMING AND MONTANA,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04163

WATER RESOURCES OF OLEY TOWNSHIP, BERKS COUNTY, PENNSYLVANIA,
Geological Survey, Dover, DE. Water Resources Div.
G. N. Paulachok, and C. R. Wood.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4065, 1988. 60p, 14 fig, 2 plates, 15 tab, 17 ref, glossary.

Descriptors: *Pennsylvania, *Groundwater, *Water yield, *Water table, *Carbonate aquifers, *Base runoff, *Hydrologic budget, *Well yield, Nitrates, Coliforms, Water wells, Water quality.

Half of Oley Township, Pennsylvania is underlain by highly permeable carbonate rocks. Nondomestic wells in these rocks typically have yields of 200 gal/min, and some wells yield more than 1,000 gal/min. The remainder of the township is underlain by rocks of low permeability, and some wells do not yield enough water for domestic supplies. A water table map shows that two active quarries in low permeability rocks have had little effect on the hydrologic system. Groundwater yield for Oley Township is about 0.5 million gal/day/sq mi. Specific yields are about 4.5% for the carbonate rocks as a whole; 5% for the quartzite, granite, and gneiss; 1% for the noncarbonate sedimentary rocks; and 1.5% for the Jacksonburg Limestone, which consists of argillaceous limestone. In a year of average precipitation, the groundwater contribution to total streamflow ranged from 56 to 88%. Basins with the highest percentage of carbonate rock contribute the largest amount of groundwater to streamflow. Water from 3 of 19 wells in carbonate rocks had nitrate concentrations in excess of 10 mg/L. Five of the 19 wells had fecal streptococci bacteria counts of more than 20 colonies/100 ml. (USGS)
W89-04164

CHANNEL INFILTRATION ALONG THE PAWNEE RIVER AND ITS TRIBUTARIES, WEST CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04169

REGIONAL GROUNDWATER DISCHARGE TO LARGE STREAMS IN THE UPPER COASTAL PLAIN OF SOUTH CAROLINA AND PARTS OF NORTH CAROLINA AND GEORGIA,
Geological Survey, Columbia, SC. Water Resources Div.
W. R. Aucott, R. S. Meadows, and G. G. Patterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4332, 1987. 28p, 12 fig, 12 tabs, 22 ref.

Descriptors: *Base flow, *Surface-groundwater relations, *Groundwater, *South Carolina, Coastal Plains.

Base flow was computed to estimate discharge from regional aquifers for six large streams in the upper Coastal Plain of South Carolina and parts of North Carolina and Georgia. Aquifers that sustain the base flow of both large and small streams are stratified into shallow and deep flow systems. Base-flow during dry conditions on main stems of large streams was assumed to be the discharge from the deep groundwater flow system. Six streams were analyzed: the Savannah, South and North Fork Edisto, Lynches, Pee Dee, and the Luber Rivers. Stream reaches in the Upper Coastal Plain were studied because of the relatively large aquifer discharge in these areas in comparison to the lower Coastal Plain. Estimates of discharge from the deep groundwater flow system to the six large streams averaged 1.8 cu ft/sec/mi of stream and 0.11 cu ft/sec/sq mi of surface drainage area. The estimates were made by subtracting all tributary inflows from the discharge gain between two gaging stations on a large stream during an extreme low-flow period. These estimates pertain only to flow in the deep groundwater flow system. Shallow flow systems and total base flow are > flow in the deep system. (USGS)
W89-04173

GROUNDWATER LEVELS IN THE LOWER PALEOZOIC AND PRECAMBRIAN CRYSTALLINE ROCKS OF SOUTHEASTERN CHESTER COUNTY, PENNSYLVANIA, JULY AND AUGUST 1986,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04174

GEOHYDROLOGIC CONDITIONS AT THE NUCLEAR FUEL REPROCESSING PLANT AND WASTE-MANAGEMENT FACILITIES AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04178

GEOLOGY AND HYDROLOGY OF DEEP BEDROCK AQUIFERS IN EASTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
S. G. Robson, and E. R. Banta.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4240, 1987. 6 pl, 27 fig, 100 ref.

Descriptors: *Geohydrology, *Bedrock, *Aquifers, *Recharge, *Water quality, *Colorado, *Maps, Aquifer characteristics, Aquifer systems, Temperature, Laramie Formation, Fox Hills Sandstone, Fort Hays Limestone, Codell Sandstone, Dakota Sandstone, Cheyenne Sandstone, Entrada Sandstone, Sundance Formation, Dockum Group, Lyons Sandstone, Fountain Formation, Sangre de Cristo Formation.

Deep bedrock aquifers are present in rocks of Cretaceous through Pennsylvanian age in eastern Colorado. These aquifers are the Laramie-Fox Hills (the uppermost aquifer studied), Fort Hays-Codell, Dakota-Cheyenne, Entrada-Dockum, Lyons, and Fountain. Structural mapping indicates the aquifers are 2,000 to 9,000 ft below land surface in most of eastern Colorado but outcrop in local areas in a narrow band along the Front Range of the Rocky Mountains. Recharge primarily occurs in outcrops and produces a northerly or easterly groundwater flow to discharge areas along the South Platte or Arkansas Rivers. Deep aquifers also discharge by underflow to Kansas and Nebraska. Some water-yielding strata in the Dakota-Cheyenne aquifer are not in hydraulic connection with the aquifer, and abnormal fluid pressures, trapped hydrocarbons, and high dissolved-solids concentrations are found in these strata. Temperature and dissolved-solids mapping indicate water temperatures of 100 to 210 in northeastern Colorado and a zone of relatively fresh water extending through a 7,000 sq mi area of the Dakota-Cheyenne aquifer in southeastern Colorado. Water levels in the Laramie-Fox Hills aquifer continue to decline as much as 12 ft/yr in local areas near Denver. (USGS)
W89-04179

SEMI ANALYTICAL SOLUTION FOR THE GROUNDWATER MOUND PROBLEM,
Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Mathematik und Informatik.
G. Schmitz, and J. Edenhofer.
Advances in Water Resources AWREDI, Vol. 11, p 21-24, March 1988. 3 fig, 6 ref.

Descriptors: *Groundwater management, *Artificial recharge, *Water table profiles, *Free surfaces, *Mathematical analysis, *Groundwater level, *Groundwater movement, Water table rise, Water table fluctuations, Recharge basins, Infiltration, Aeration zone, Soil treatment, Laplace equation, Environmental engineering.

Artificial recharge as a means of managing the water resources of a region has been increasingly applied during the last decade. The groundwater table rises under these recharge basins and poses engineering, as well as health, problems. Thus, the computation of the transient-mound geometry in the vicinity of recharge basins is a highly-important step in the planning of groundwater-replenishment activities and is also required when using the unsaturated soil zone--in which high degrees of physical, biological, and chemical treatment occur--to improve the quality of the infiltrating water. A basically new principle to treat the problem of the transient location of phreatic surfaces under recharge basins is presented. No simplifying assumptions or linearization of phreatic-surface conditions have been employed. The approach avoids discretization techniques and leads, by the means of conformal mapping and the theory of complex functions, to an analytical solution of the Laplace Equation for a nonrectangular domain. A first application of the new formula to calculate a corresponding pair of functions of the free-surface profile and recharge shows that this solution may become a promising tool to solve engineering problems in that field. However, a considerable amount of research work still seems to be necessary before all potentialities of the new approach will have been explored and exploited. (Shidler-PTT)
W89-04242

FINITE ELEMENT MODELLING OF RECIRCULATING DENSITY-DRIVEN SALTWATER INTRUSION PROCESSES IN GROUNDWATER,
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Matematik und Mechanik.
H.-J. Diersch.
Advances in Water Resources AWREDI, Vol. 11, p 25-43, March 1988. 13 fig, 2 tab. 23 ref.

Descriptors: *Groundwater, *Computer models, *Finite element method, *Saline water intrusion, *Density currents, Groundwater pollution, Solute transport, Free surfaces, Saline-freshwater interfaces, Upconing, Salinity currents, Numerical analysis, Comparison studies, Simulation analysis, Computer programs.

In the field of groundwater-contamination research there is an increasing interest in modeling saltwater-transport processes. An appropriate finite-element model (FEM) for solving transient and steady-state density-driven saltwater-intrusion processes in groundwater with or without free surface is described. Alternative formulations and several numerical-solution strategies are discussed. A comparative study is given for a cellular-benchmark problem. An implicit predictor/corrector method with automatically-adjusted time stepping involving a one-step Newton method is studied. Results on saltwater-wedge displacement and gravity-driven sinking of salt water from a deposit into the subsurface illustrate the efficacy of the model chosen. The results for the saltwater-wedge problems are compared with analytical sharp-interface assessments. There were significant differences between miscible and immiscible approaches, where the sharp-interface solutions predicted distinctly-faster saltwater movement. In essence, the finite-element model is designed as a software-system component for use in decision-oriented interactive simulation. Further development will connect 'time-step automation' with judicious mesh-adaptation techniques to further smooth the way for efficient use of the FEM by nontechnical (non-FEM-expert) users. (Shidler-PTT)
W89-04243

HYDROGEOLOGY AND AQUIFER SIMULATION OF THE BASEMENT ROCKS OF THE KADUNA-ZAIRIA AREA, NORTHERN NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Geology.
For primary bibliographic entry see Field 4B.
W89-04244

NON-DIMENSIONAL DIAGRAMS FOR UNSTEADY DRAINAGE PROBLEMS WITH OR WITHOUT RECHARGE,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
D. Karamouzis, T. Zissis, and G. Terzidis.
Agricultural Water Management AWMADF, Vol, 13, No. 2-4, p 145-156, June 1988. 9 fig, 17 ref.

Descriptors: *Subsurface drainage, *Groundwater movement, *Graphical analysis, *Recharge, *Soil water table, Root zone, Soil Aeration, Waterlogging, Saline water intrusion, Unsteady flow, Finite difference methods, Finite element method.

Subsurface drainage is a very important factor in agriculture because, by draining excess water, it provides aeration and prevents water-logging and salinization of the plant root zone. The analytical solutions for three common drainage cases are presented in the form of two exponential series. These cases are: (1) drainage without recharge; (2) drainage with recharge from rainfall or irrigation; and (3) drainage with recharge from rainfall or irrigation as well as from the semi-impervious base. Exponential series were calculated by computer and are presented in two non-dimensional diagrams, for easy application to practical problems. From these diagrams, the values of the water table at mid-distance between parallel drains and the discharge per unit area into the drains, can be calculated. The same drainage problems were solved numerically by finite differences (FDM) and finite elements (FEM). Comparison between numerical and analytical solutions shows satisfactory agreement. (Author's abstract)
W89-04259

EFFECT OF SHELTERBELTS ON GROUNDWATER FORMATION,
All-Union Research Inst. of Agricultural Forest Reclamation, Volgograd (USSR).
A. M. Byalyy.
Soviet Soil Science SSSCAE, Vol. 20, No. 1, p 80-87, January-February 1988. 5 tab, 10 ref. Translated from Pochvovedniye, No. 9:32-39, 1987.

Descriptors: *Groundwater recharge, *Soil water, *Forest hydrology, Snowmelt, Chernozem soils, Shelterwood systems, Mineralization, Infiltration, Aquifers, Water table, USSR.

Studies were made of groundwater in shelterwood systems of Chernozems. Anthropogenic groundwater as a manifestation of the soil water regime is shown to form in forest agrarian landscapes. Its formation under new conditions is caused mainly by spring snowmelt and its internal soil flow. As a result, the former nonpercolating type of water regime in forest agrarian landscapes of Chernozems is transformed into a percolating type. Under new conditions the processes of mineralization follow the pattern observed under automorphic

conditions, where infiltration contributes to a freshening of the soil profile. (Author's abstract)
W89-04281

EXTERNALITY AND EQUITY IMPLICATIONS OF PRIVATE EXPLOITATION OF GROUND-WATER RESOURCES,
Institute of Rural Management, Anand (India).
For primary bibliographic entry see Field 6E.
W89-04303

DISTRIBUTION AND FORMATION OF HIGH-FLUORINE GROUNDWATER IN CHINA,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2K.
W89-04321

FEATURES OF NATURAL ENVIRONMENT AND OCCURRENCE OF GROUNDWATER IN COLD ARTESIAN BASINS IN PERMAFROST AREAS, CHINA.
Heilongjiang Forestry Design Research Inst., Harbin (China).
L. Feng-Tong.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 43-47 August 1988. 4 fig, 3 tab, 3 ref.

Descriptors: *Artesian basins, *Groundwater recharge, *Cold regions, *Permafrost, *China, *Huola River Basin, Melting, Temperature effects, Vegetation effects, Peat, Precipitation, Infiltration, Permeability, Drainage.

The features of the natural environment of the Huola River artesian water basin in Guilan District, Mohe County, in the Xin-an Region are described and the interrelationship of various factors of underground water under glacial conditions are depicted. The Huola River artesian basin is in the permafrost region of northeastern China. The permafrost drainage is poor. The ground is covered with dense mosses on which slender bushes are growing. Criss-cross grass roots and the remains of plants that are not easily decomposed cause the formation of a very thick layer of peat which hampers the growth of new trees. The artesian water basin is strictly controlled by permafrost. The continuous area of permafrost is about 60.7 of the basin. The melting zone is primarily distributed on top of the surrounding low hills, sunny or partly-sunny hilsides, and in the fan-like alluvial-deluvium part where there is surface water, or a gravel sandy soil with a dry surface and good air and water permeability. The vegetation, ground temperature, and depth of yearly change of the permafrost have an impact on the environment. As the continuity and thickness of permafrost increases, infiltration decreases. Recharge of groundwater is prevented by impermeable permafrost. Atmospheric precipitation, surface water, lake (swamp) water, and underground water in various melting zones running through melting zones and along melting fractural passages infiltrates initially into the broken underground parts from the surrounding fractures and then into the pores and fissures between the strata. Most of the surrounding groundwater recharge area is characterized by shallow burial of groundwater, thin frozen ground, and no artesian pressure; near the center of the basin, groundwater is deep and permafrost is thick and confining. (Davis-PTT)
W89-04323

GROUNDWATER RESOURCES IN THE NORTH CHINA PLAIN,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
F. Jin.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 63-67, August 1987. 2 fig, 2 ref.

Descriptors: *Groundwater budget, *Precipitation, *River systems, *China, *Groundwater management, *Water demand, *Water supply development, North China Plain, Yellow River, Bohai Sea, Aquifers, Haihe River, Launhe River, Desalination, Saline-freshwater interfaces, Water reuse, Industrial water, Water deficit.

Shallow groundwater is a major object of exploitation in the North China Plain. About 20 billion cu m/yr of fresh groundwater and about 20 billion cu m/yr of surface water are available. There are three river systems in the plain: the Haihe, Launhe, and the Yellow River. There are also some dry rivers which drain nearby waterlogged areas in rainy seasons; such rivers are the Douhai, Majia, and Heilonggang. In the piedmont area to the west and the north of the plain, the aquifers are better recharged, more permeable, have good water quality, and the water table is deep. In the middle part of the plain, the shallow fresh water aquifers are, primarily, fine sand, and secondarily, fine medium sand and silt. Deeper freshwater aquifers are distributed evenly throughout the region and consist primarily of medium-fine and fine sands. In coastal areas in the North China Plain there are saltwater-freshwater relationships. According to statistics, industrial and agricultural water demand has already reached 40 billion cu m/yr, and consequently, an intense water supply problem exists in the North China Plain. To solve this problem, many hydrologists suggest diverting water from the south to the north; from the Yangtze River and Yellow River to the North China Plain. More realistic ways to solve the situation include: elimination of water waste; strengthening the control of water resources, especially groundwater; making a rational plan for industrial and agricultural development according to water resource availability; enhancing the regulation and management of surface water; and researching ways to increase the amount of utilizable water, such as reutilization of industrial wastewater, desalinization of groundwater, and sea water utilization. (Davis-PTT)
W89-04324

SINKHOLE MANAGEMENT AND FLOODING IN JAMAICA,
World Meteorological Organization, Kingston (Jamaica).
For primary bibliographic entry see Field 4A.
W89-04325

PESTICIDE TRANSPORT IN SHALLOW GROUNDWATER,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W89-04382

2G. Water In Soils

MODELING SEASONALLY FREEZING GROUND CONDITIONS,
Bristol Univ. (England).
For primary bibliographic entry see Field 2C.
W89-03383

HIGH-RESOLUTION SAMPLER OF SURFACE PEAT,
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 7B.
W89-03392

DISTRIBUTION COEFFICIENTS OF RADIONUCLIDES BETWEEN SOILS AND GROUNDWATERS AND THEIR DEPENDENCE ON VARIOUS TEST PARAMETERS,
British Nuclear Fuels Ltd., Sellafield (England).
For primary bibliographic entry see Field 5B.
W89-03402

ANNUAL CYCLES OF PHYSICAL AND BIOLOGICAL PROPERTIES IN AN UNCULTIVATED AND AN IRRIGATED SOIL IN THE SAN JOAQUIN VALLEY OF CALIFORNIA,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
R. G. Amundson, and V. S. Smith.
Agriculture, Ecosystems and Environment, Vol. 20, No. 3, p 195-208, June 1988. 7 fig, 33 ref. HATCH project CA-B*-PSB-4436-H.

Descriptors: *Irrigation effects, *Soil water, *Soil temperature, *Carbon dioxide, *Irrigation effects, *California, *Seasonal variation, San Joaquin Valley, Soil physical properties, Organic carbon, Respiration, Soil organic matter, Cycling nutrients.

The temperature, moisture and carbon-dioxide content in the western San Joaquin Valley were monitored for more than 1 year in order to determine the degree to which irrigated agriculture affected the annual variations of these important ecological properties. The uncultivated soil underwent strong seasonal changes in moisture and carbon dioxide, the highest values being obtained in the late winter and early spring and the lowest occurring in the late summer and early autumn. In contrast, as adequate moisture for biological activity was available year round in the irrigated soil, the carbon-dioxide levels varied in response to variations in temperature. The organic-carbon content of the irrigated soil was half that of the uncultivated soil (1.8 versus 3.6 kg/square m), presumably owing to an enhanced level of organic-matter decomposition in the irrigated soil. Calculated annual rates of soil respiration for the two soils were nearly identical (0.25 g/square m/h). Based on estimates of annual biomass production in the uncultivated soil, it was estimated that the mean residence time of soil organic matter was approximately 61 years. Although this estimate indicates a relatively rapid turnover of C, it is consistent with previous work indicating rapid nutrient cycling in annual grasslands. (Author's abstract)
W89-03411

PATTERNS OF WATER WITHDRAWAL BENEATH AN IRRIGATED PEACH ORCHARD ON A RED-BROWN EARTH,
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinity.
For primary bibliographic entry see Field 3F.
W89-03422

SIMULATION OF THE SOIL-WATER DYNAMICS AND CORN YIELDS UNDER DEFICIT IRRIGATION,
Katholieke Univ. Leuven (Belgium). Soil and Water Engineering Lab.
For primary bibliographic entry see Field 3F.
W89-03423

GROWTH AND YIELD OF SOYBEANS UNDER WET SOIL CULTURE AND CONVENTIONAL FURROW IRRIGATION IN SOUTH-EASTERN AUSTRALIA,
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinty.
For primary bibliographic entry see Field 3F.
W89-03424

COTTON GROWTH AND PRODUCTION UNDER DRIP-IRRIGATION RESTRICTED SOIL WETTING,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 3F.
W89-03425

MOVEMENT AND SPECIATION OF HEAVY METALS IN A SOIL AMENDED WITH SEWAGE SLUDGE CONTAINING LARGE AMOUNT OF CD AND NI (MIGRATION ET SPECIATION DES METAUX LOURDS DANS UN SOL SOUMIS A DES EPANDAGES DE BOUES DE STATION D'EPURATION A TRES FORTE CHARGE EN CD ET NI),
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 5B.
W89-03431

MASS EXCHANGE BETWEEN MOBILE FRESHWATER AND IMMOBILE SALINE WATER IN THE UNSATURATED ZONE,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
H. Gvirtzman, N. Paldor, M. Magaritz, and Y. Bachmat.
Water Resources Research WRERAQ, Vol. 24, No. 10, p 1638-1644, October 1988. 7 fig, 1 tab, 24 ref.

Descriptors: *Aeration zone, *Saline-freshwater interfaces, *Mass transfer, *Radioisotopes, *Saline water, Mathematical models, Loess, Sediments, Tritium, Groundwater movement, Stagnant water.

A profile of tritium concentrations measured in the unsaturated zone in loessial sediments in a semiarid area is interpreted in terms of mobile and immobile water domains, according to a nonequilibrium transport model. The mobile domain is represented by percolating freshwater from both rain and irrigation, and the immobile one is represented by isolated fossil saline water pockets. The two domains are connected by partially saturated narrow passages within dispersed clay minerals. The transport of the mobile water is described by convective-dispersive flow and by mass exchange between the two water domains. The relevant equations with the given initial and boundary conditions are solved numerically, and the simulated profile is adjusted to fit the measured one. In this study examination of the mass exchange law between the two domains is concentrated on. It was assumed that matrix characteristics vary in time due to the dispersion of clays at the interface between fresh and saline waters. Accordingly, a time-dependent mass exchange was adopted, which made it possible to obtain an adequate reconstruction of the measured tritium profile. By using a least squares optimization procedure it was found that the best fit between the simulated and measured profiles is attained when the fraction of mobile water is 30%, and the rate of mass exchange decreases from 0.60 to 0.01/year in 26 years. The proposed model implies that it is the immobile water domain which contains the memory of the 'high tritium period' (thermonuclear tests period) of the 1960s. (Author's abstract)
W89-03802

COMPARISON OF ACTIVE MICROWAVE SOIL WATER CONTENT WITH INFRARED SURFACE TEMPERATURES AND SURFACE MOISTURE AVAILABILITY,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 7B.
W89-03818

EVALUATION OF A DRAINAGE COEFFICIENT FOR BROOKSTON CLAY SOIL,
Guelph Univ. (Ontario). School of Engineering.
R. W. Irwin, G. J. Bryant, M. R. Toombs, and J. A. Stone.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1343-1346, September-October 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Clay loam, *Drainage coefficient, *Tile drainage, Soil types, Seasonal variations.

Over 1,900 tile drainage discharge events were analyzed to evaluate the drainage coefficient of a Brookston clay loam soil. Only 71% of the discharge events had a duration of 24 h or greater. Of these 71%, 32% occurred in March, April and May, 12% occurred from June through October, and 56% occurred from November through February. Average 24-h discharge depths varied during the year but were highest in August to September due to rainfall occurring on cracked soil. A drainage coefficient can be associated with each season. The probability of an annual drainage coefficient of 11.5 mm/day is 50%. If a longer period of time is chosen for a drainage event, the required flow capacity of the collector drain is reduced and the cost may be decreased. (Author's abstract)
W89-03827

SOLUTE TRANSPORT UNDER NO-TILL FIELD CORN,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 5B.
W89-03828

ECONOMIC OPTIMIZATION OF FURROW IRRIGATION WITH UNIFORM AND NONUNIFORM SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W89-03836

AUTOMATED IN SITU MEASUREMENT OF UNSATURATED SOIL WATER FLUX,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
J. J. M. Van Grinsven, H. W. G. Booltink, C. Dirksen, N. Van Breemen, and N. Bongers.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1215-1218, September-October 1988. 4 fig, 1 tab, 16 ref.

Descriptors: *Aeration, *Measuring instruments, *Automation, *Unsaturated flow, *Soil water, Fluxmeters, Soil analysis, Sand, Hydrologic models, Mathematical models, Computers, Hydrologic budget, In situ tests.

A device is presented which, based on new operation principles, intercepts unsaturated soil water fluxes within an error of 10% and can yield samples for subsequent chemical analysis and calculation of convective solute fluxes. Operation is controlled by a microprocessor which automatically adjusts the vacuum imposed on a porous filter cloth such that identical matrix potentials are maintained just above the cloth and at the same depth in the neighboring soil. Contact resistances and internal resistance of the device are implicitly corrected by adjustment of suction. Laboratory and field tests in a loamy sand under steady and transient flow conditions showed that cumulative water fluxes could be measured within 10% of those calculated from storage changes, and from numerical and analytical flow models. (Author's abstract)
W89-03897

COMPARISON OF A LABORATORY PROCEDURE AND A TEXTURAL MODEL FOR PREDICTING IN SITU SOIL WATER RETENTION,
North Dakota State Water Commission, Bismarck. Hydrology Div.
W. M. Schuh, R. L. Cline, and M. D. Sweeney.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1218-1227, September-October 1988. 8 fig, 2 tab, 31 ref.

Descriptors: *Mathematical models, *Soil water, *Soil moisture retention, *Model testing, Comparison studies, In situ tests, Density, Silt, Particle size, Tensiometers, Loam, Sand, Soil texture, Interstitial water, Soil pressure, Soil water potential, Soil horizons.

A physico-empirical model for predicting the soil moisture characteristic curve using particle size and bulk density data was compared with a commonly used laboratory method using undisturbed core samples and a pressure plate extractor, for precision in estimating in situ water retention measured with paired neutron probe and tensiometer installations. An empirical factor for the model was found to average close to the value (alpha = 1.38) proposed by its authors. Values for this experiment were different between texture classes. Loam and silt loam values were constant, while values for soils of sand, loamy sand, and sandy loam texture were nonconstant. The empirical factor was calibrated for (1) loam and coarse loam; (2) silt loam; and (3) sand, loamy sand, and sandy loam texture groups. The sandy soil values required linear calibration as a function of soil water potential. Results for the calibrated model compared well, overall, with laboratory determinations on soils ranging in texture from sand to loam and silt loam. Laboratory estimates were slightly better for A and B horizon materials, while model estimates were better for C horizons. Error for estimation of field volumetric water content using model and lab methods was approximately twice the error for estimation of potentially water filled porosity using a second field neutron-tensiometer installation within one meter of the first field apparatus. (Author's abstract)
W89-03898

GENERALIZED SOLUTION TO INFILTRATION FROM A SURFACE POINT SOURCE,
Geological Survey, Lakewood, CO. Water Resources Div.
R. W. Healy, and A. W. Warrick.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1245-1251, September-October 1988. 4 fig, 3 tab, 21 ref.

Descriptors: *Infiltration, *Groundwater movement, *Numerical analysis, Mathematical models, Finite difference methods, Trickle irrigation, Permeability coefficient, Soil water, Wetting, Irrigation design, Surface irrigation.

A method is presented for the estimation of the time-variant extent of the wetting front and wetted volume that develop in soil in response to infiltration from a surface point source. The method is based on a numerical finite-differences solution of a dimensionless form of Richard's equation for axially symmetric flow. The generalized solutions are obtained from empirical equations, the coefficients for which are contained in a single table for a variety of soils and source strengths. Results for specific locations are obtained by application of scaling factors to the generalized results and possibly some interpolation. The method should be of particular value in the design of trickle irrigation systems by allowing simple estimation of rates and lengths of water application, as well as spacing between water emitters. (Author's abstract)
W89-03899

MODELING THE TRANSPORT OF INORGANIC IONS THROUGH UNDISTURBED SOIL COLUMNS FROM TWO CONTRASTING WATERSHEDS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. M. Jardine, G. V. Wilson, and R. J. Luxmoore.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1252-1259, September-October 1988. 8 fig, 3 tab, 36 ref.

Descriptors: *Ion transport, *Soil water, *Adsorption, *Saturated flow, *Model studies, *Solute transport, Infiltration, Tracers, Soil columns, Anions, Cations, Convection, Ion exchange, Nitrates, Ammonia, Magnesium, Bromine.

The transport of several inorganic cations and anions (Mg2+, NH4-, Br-, NO3-), via saturated flow, through large undisturbed soil columns was investigated. The mobility of nonreactive tracers was described well with the convection-dispersion (CD) equation using flux-averaged solute detection in the effluent. Reactive tracers were also modeled well using various linear and nonlinear, equilibrium and nonequilibrium, transport codes based on the CD equation. Appropriate independent estimates of model predicted chemical retardation were possible only through experimental development of dynamic isotherms using a steady flow method on small undisturbed soil columns. The latter condition can accurately predict solute retardation on large soil columns, since tracer movement is largely controlled by the physical aspects of the soil (e.g., preferential flow zones). Adsorption isotherms generated on disturbed soils, using a batch equilibration method, overestimated the amount of solute retardation from displacement experiments on the large undisturbed soil columns. The use of batch adsorption measurements in curve-fitting transport models to describe data from saturated column displacement experiments on undisturbed soils, may result in erroneous transport parameter estimates. (Author's abstract)
W89-03900

COKRIGING POINT DATA ON MOISTURE DEFICIT,
Department of Soil Statistics, Agricultural University, Box 37, 6700 AA Wageningen, The Netherlands.
A. Stein, W. Van Dooremolen, J. Bouma, and A. K. Bregt.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1418-1423, September-October 1988. 5 fig, 6 tab, 15 ref.

Descriptors: *Soil moisture deficiency, *Soil moisture retention, *Water table fluctuations, *Prediction, *Data interpretation, *Kriging, *Statistical methods, *San Joaquin Valley, *Water pollution sources, *Soil chemistry, Simulation analysis, The Netherlands, Soil water, Permeability coefficient, Hydrological data collections, Soil surveys.

Existing computer calculations by simulation of the moisture deficit (MD) were used for 500 point observations in an area of 404 ha with sandy soils in the Netherlands. The statistical prediction techniques kriging and cokriging were used to predict MD-values in 100 points selected at random from the 500 available points. The MD-data at the remaining 400 points were used for the predictions. The mean variance of prediction error (MVPE) and the mean squared error of prediction (MSEP) decreased only slightly when kriging is compared with cokriging using the mean highest water-table level as a covariable. The number of MD-values used in cokriging could, however, be reduced from 400 to 160 with only a small loss of accuracy in using 400 observations on the mean highest water-table (MHW) as a covariable. As the MD-variables being considered are four times as expensive to determine as the covariable, which is routinely estimated during soil survey, this also represents a considerable reduction of costs. Cokriging can thus be a useful technique to more effectively utilize available soil survey information. (Author's abstract)
W89-03902

DROP IMPACT ENERGY: SOIL EXCHANGEABLE SODIUM PERCENTAGE INTERACTIONS IN SEAL FORMATION,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 2K.
W89-03904

POLYMER AND WATER QUALITY EFFECTS ON FLOCCULATION OF MONTMORILLONITE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-03905

GAS DIFFUSION, FLUID FLOW AND DERIVED PORE CONTINUITY INDICES IN RELATION TO VEHICLE TRAFFIC AND TILLAGE,
Scottish Inst. of Agricultural Engineering, Penicuik.
B. C. Ball, M. F. O'Sullivan, and R. Hunter.
Journal of Soil Science JSSCAH, Vol. 39, No. 3, p 327-339, September 1988. 3 fig, 8 tab, 29 ref.

Descriptors: *Soil porosity, *Cultivation, *Permeability, *Soil gases, *Soil water, *Soil compaction, Diffusion coefficient, Mathematical studies, Soil water potential, Soil texture, Permeability coefficient, Regression analysis.

Relative gas diffusivity, air permeability and hydraulic conductivity were measured in undisturbed soil cores from tillage and traffic experiments. Continuity indices were taken as the quotient of relative diffusivity and air-filled porosity). These were applied to individual measurements or to treatment means. More general continuity indices were derived from the changes in flow or diffusion with porosity, where the variations in porosity were due to both field variability and applied changes of water potential. These indices were the exponent in the relationship between relative diffusivity and air-filled porosity and the slope of log-log plots of air permeability and air-filled porosity or hydraulic conductivity and degree of saturation. Some physical significance was attached to the exponents by comparison with models of soil porosity. Positive intercepts of the relative diffusivity or air permeability plots on the air-filled porosity axes were taken as porosities blocked to gas movement. Continuity indices and flow measurements showed differences between tillage and traffic treatments which did not necessarily reflect differences in bulk density. Intrinsic permeability was better estimated from air permeability than from unsaturated hydraulic conductivity. (Author's abstract)
W89-03915

HYDRAULIC CONDUCTIVITY PROFILES OF TWO CLAY SOILS,
Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
E. G. Youngs, and M. J. Goss.
Journal of Soil Science JSSCAH, Vol. 39, No. 3, p 341-345, September 1988. 1 fig, 1 tab, 12 ref.

Descriptors: *Permeability coefficient, *Piezometers, Soil profiles, *Infiltration, *Hydraulic conductivity, *Soil saturation, *Clays, Soil texture, Hydraulic permeability, Soil compaction, Soil types.

The profiles of hydraulic conductivity for an Evesham Series and a Denchworth Series soil were measured for saturated conditions in the field when the water-table was near to the soil surface, making use of existing piezometers installed horizontally from inspection pits. The hydraulic conductivity profiles of both soils were found to be practically the same, decreasing from about 100 mm/day at a depth of 0.5 m to about 0.01 mm/day at 1.5 m. At any depth the variation in the measured hydraulic conductivity obtained from different piezometer installations in both soils was as great as that between the two soils. Hydraulic conductivity values of the Evesham soil obtained using piezometers agreed with other published results obtained with the auger-hole method on the same site. Also the hydraulic conductivity profile to 1 m depth obtained for this soil was the same as that found for a monolith, 0.8 m in diameter, taken from an Evesham soil some 100 km away. The results give encouragement to the possibility of inferring hydraulic conductivity values from soil morphological descriptions. (Author's abstract)
W89-03916

NEW CONTINUOUS-SAMPLING WIRELINE SYSTEM FOR ACQUISITION OF UNCONTAMINATED, MINIMALLY DISTURBED SOIL SAMPLES,
For primary bibliographic entry see Field 7B.
W89-03920

VISCOSITY AND DIELECTRIC CONSTANT CONTROLS ON THE HYDRAULIC CONDUCTIVITY OF CLAYEY SOILS PERMEATED WITH WATER-SOLUBLE ORGANICS,
University of Western Ontario, London. Faculty of Engineering Science.
F. Fernandez, and R. M. Quigley.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 3, p 582-289, August 1988. 12 fig, 1 tab, 11 ref.

Descriptors: *Dissolved solids, *Soil waters, *Landfills, *Linings, *Path of pollutants, *Hydraulic conductivity, *Clays, *Leachates, Hydrocarbons, Alcohols, Permeability, Stress analysis, Electrical properties, Viscosity.

Water-soluble organic liquids may dramatically increase the hydraulic conductivity, k, of water-saturated clayey soils, thus destroying their effectiveness as barriers for contaminants. Double-layer contraction at constant void ratio with resultant increases in the pore space available for flow has been identified as a primary mechanism for such increases in k. This paper shows that the increased viscosity of solutions of some organics in water results in significant decreases in k. Pure alcohols and other water solubles when permeated through water-compacted clay samples produce an initial decrease in k, followed by a gradual increase to equilibrium values. The 'hydrocarbon' front raises the viscosity of the pore fluid and causes an initial drop in k. Tests using aqueous solutions of ethanol and dioxane show decreases in k at concentration up to approximately 70 percent. Only at high concentrations does the dielectric constant, double-layer effect overcome the viscosity effect and produce net increases in k. Effective stresses of 160 kPa during permeation with ethanol and dioxane prevent the increases in k. Physicochemically induced consolidation and increased k (sub 0) shearing effects that close shrinkage cracks are operative. (Author's abstract)
W89-03972

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: II. FIELD VERIFICATION OF THE THRESHOLD MODEL APPROACH,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 7C.
W89-03985

MULTIVARIATE STATISTICAL ANALYSIS OF POTASSIUM AND CHLORIDE REDISTRIBUTION FROM A LINE-SOURCE SPRINKLER EXPERIMENT,
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-04011

QUASI-ANALYTICAL SOLUTIONS OF THE SOIL WATER FLOW EQUATION FOR PROBLEMS OF EVAPORATION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
M. D. Novak.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 916-924, July/August 1988. 4 fig, 5 tab, 22 ref.

Descriptors: *Numerical analysis, *Soil water, *Flow, *Evaporation, Hydraulics, Mathematical equations, Soil science, Boundary conditions, Mathematical studies, Soil columns.

Quasi-analytical solutions of the one-dimensional soil water flow equation applied to problems of evaporation are derived and compared with exact numerical solutions available in the literature. Constant-concentration and constant-flux surface boundary conditions and semi-infinite and finite soil columns are considered. For the semi-infinite soils, the quasi-analytical technique of Philip and Knight (1974) is very successful in predicting the water content profiles for the constant-concentration condition, and only moderately so for the constant-flux condition. Their iterative procedure for the flux-concentration function converges rapidly in the constant-concentration case, but an analogous procedure diverges in the constant-flux case. For finite soils, the simple assumption that the rate of drying of the column is independent of depth in the flow equation leads to accurate predictions of the water content profiles for the constant-concentration case, and for the constant-flux case if the potential evaporation is low, the soil is shallow, and/or the initial hydraulic diffusivity is high. For conditions other than these, roughly accounting for the higher rate of drying that occurs near the surface in this case greatly improves the agreement. (Author's abstract)
W89-04012

CONSOLIDATION OF AN UNSATURATED ILLITIC CLAY SOIL,
National Soil Erosion Lab., West Lafayette, IN.
For primary bibliographic entry see Field 8D.
W89-04013

TEMPORAL PERSISTENCE OF SPATIAL PATTERNS OF SOIL WATER CONTENT IN THE TILLED LAYER UNDER A CORN CROP,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
I. J. van Wesenbeeck, R. G. Kachanoski, and D. E. Rolston.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 934-941, July/August 1988. 7 fig, 1 tab, 18 ref.

Descriptors: *Soil water, *Corn, *Cultivation, *Soil-water-planttionships, Drying, Distribution, Recharge, Evapotranspiration, Spatialribution, Temporal distribution, Dynamics, Soil science, Mathematicalysis, Rainfall, Hydraulics.

The temporal persistence of the spatial pattern of soil water storage (0-0.2 m) under a corn (Zea mays) canopy during drying and recharge periods was examined using spatial coherency analysis and transfer function theory. The corn crop caused both drying and recharge to occur at very specific scales, equal to the crop row spacing. The calculated transfer function, or time varying spectrum showed the scale at which the change in the spatial pattern was occurring and quantified the increase or decrease in variance at that scale. The spatial pattern of the drying coefficients, a measure of the relative drying rate, also varied systematically with significantly higher drying rates in the row area developing as the growing season progressed. The increase in relative drying rate in the row area caused the spatial pattern of drying to change at a scale equal to the crop row spacing. The calculated transfer function of the drying coefficients over the growing season indicated a steady increase in variance at that same scale, while the variance at other scales did not change significantly. An equation is debeloped relating the transfer function of soil water content in space to the spectrum of the process causing the change in the spatial domain. (Author's abstract)
W89-04014

INHIBITION OF HYDROXYAPATITE PRECIPITATION IN THE PRESENCE OF FULVIC, HUMIC, AND TANNIC ACIDS,
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
W. P. Inskeep, and J. C. Silvertooth.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 941-946, July/August 1988. 5 fig, 2 tab, 32 ref. Okla. Agric. Exp. Stn. Project H-1963; Mont. Agric. Exp. Stn. Project 322.

Descriptors: *Soil chemistry, *Organic acids, *Chemical precipitation, *Phosphorus compounds, *Chemical properties, Kinetics, Adsorption, Chemical reactions, Carbon, Organic carbon, Phosphorus, Fulvic acids, Humic acids, Phosphates, Sludge, Manure, Farm wastes.

The kinetics of precipitation of hydroxyapatite (HAP) may be important in explaining the oversaturation of many natural waters with respect to pure HAP. Consequently, the objectives of this study were to determine the rate of HAP precipitation in the absence and presence of organic acids commonly found in soil solutions, which might act as potential inhibitors of solid phase precipitation. The forward rate of HAP precipitation (R) between pH 7.4 to 8.4 was found to decrease in the presence of fulvic, humic, or tannic acid. The mechanism of precipitation inhibition in the presence of these acids appears to be adsorption of the organic ligand on the HAP seed crystals, thereby blocking sites for crystal growth. Smaller molecular weight organic acids such as citric, gallic, syringic, adipic, and azealic acid were not as effective at inhibiting HAP precipitation per unit total soluble organic carbon present, which may indicate the importance of larger molecular weight acids on actual physical coverage at the HAP surface. The inhibition of HAP precipitation in the presence of humic, fulvic, and tannic acids may explain why many soil solutions are supersaturated with respect to pure HAP, and why increases in P concentrations are observed in many agricultural studies in the presence of sludge or manure. (Author's abstract)
W89-04015

FLUORESCENCE SPECTROSCOPY OF HUMIC SUBSTANCES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-04017

EFFECTS OF SIMULATED ACID RAIN ON SOIL SOLUTION COMPOSITION AND ORCHARDGRASS SEEDLING VIABILITY,
Tennessee Univ., Knoxville. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 5C.
W89-04018

SUBSOIL SATURATED HYDRAULIC CONDUCTIVITY IN RELATION TO SOIL PROPERTIES IN THE NORTH CAROLINA COASTAL PLAIN,
California Univ., Davis. Dept. of Land, Air and Water Resources.
R. J. Southard, and S. W. Buol.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 1091- 1094, July/August 1988. 1 fig, 2 tab, 16 ref.

Descriptors: *Soil water, *Subsoil, *Soil saturation, *Hydraulicuctivity, *Soil properties, *North Carolina, *Coastal plains, Hydrology,science, Soil cores, Soil structure, Regression analysis, Soil types, Pore, Flow, Saturated flow, Clays.

Laboratory measurements of saturated hydraulic conductivity (Ksat) of soil cores from nine North Carolina Coastal Plain Ultisols demonstrate that Ksat generally decreases with increasing depth, while grade of blocky structure generally becomes stronger with depth. The best single predictor of Ksat is the proportion of pores with diameters > 30 microns as calculated from water retention characteristics, followed by the coefficient of linear extensibility measured on soil pastes. Total porosity is correlated negatively with Ksat. Weighted mean ped diameter (WMPD), an indication of structure size and grade, is not significantly correlated with Ksat. Inter-ped planes of weakness are not well developed in these weakly structured soils and do not contribute much to saturated flow. Stratification of pedons by drainage class and clay content had minor effects on regression correlation. Large pores are the dominant conduits for saturated water movement in these soils as measured by the method used in this study. The proportion of large pores, probably mostly of biological origin, decreases with increasing soil depth as biological activity is attenuated. The soil pasts measurement provides an index of the potential for swelling of clay minerals and resultant constriction of water-conducting channels when soils are saturated. (Author's abstract)
W89-04019

POTENTIAL FOR BUFFERING OF ACIDIC PRECIPITATION BY MINERAL WEATHERING IN A FORESTED ENTISOL,
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5C.
W89-04020

EFFECTS OF SOIL PHYSICAL STRUCTURE ON SOLUTE TRANSPORT IN A WEATHERED TROPICAL SOIL,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
P. Sollins, and R. Radulovich.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 1168- 1173, July/August 1988. 6 fig, 34 ref.

Descriptors: *Soil water, *Soil structure, *Solute transport, *Tropical regions, *Leaching, Soil science, Flow, Soil types, Soil water, Forest soils, Clays, Pore size, Infiltration rate, Dyes, Ponding, Steady flow, Channel flow, Flow rates, Weathering, Nutrients, Dye releases.

Effects of soil structure on solute transport were studied in a clayey, well-aggregated soil under grass and secondary forest in Costa Rica. Both fine pores and coarse pores are abundant. Field application of Rhodamine B dye without ponding showed preferential flow along decayed-root channels, animal burrows, cracks, and other macropores. Dye application to intact cores under conditions of ponded steady state flow gave a good correlation between flow rate and total stained area. Solute ($CaCl_2$) breakthrough occurred very rapidly, although relative concentration of the effluent did not exceed 0.95 even after five pore volumes had percolated. This indicates that most water flows between aggregates or through macropores (as preferential or channelized flow), even when the fine pores are not fully saturated, by-passing the fine pore space. When solution inflow was interrupted after 1.8 pore volumes and resumed after 10 minutes, relative concentration of the effluent dropped by 10 to 40% and rose again, indicating that solute diffused slowly into the aggregates. Results suggest that this soil strongly resists leaching. Preferential water flow may serve to prevent nutrient loss from the matrix of all highly aggregated soils and of all noncultivated soils in which animal activity and turnover of woody roots create abundant macropores. (Author's abstract)
W89-04021

DOCUMENTATION OF COMPUTER PROGRAM VS2D TO SOLVE THE EQUATIONS OF FLUID FLOW IN VARIABLY SATURATED POROUS MEDIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04111

MULTI-GRID MODEL FOR STEADY FLOW IN A PARTIALLY SATURATED POROUS MEDIUM,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-04129

DESALINATION OF RECENTLY ACCRETED COASTAL LAND IN THE EASTERN PART OF THE BAY OF BENGAL, BANGLADESH,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 2K.
W89-04204

OPTIMIZATION TECHNIQUE FOR ESTIMATING INFILTRATION CHARACTERISTICS IN BORDER IRRIGATION,
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
For primary bibliographic entry see Field 3F.
W89-04205

SOIL-WATER DYNAMICS AND OPTIMUM OPERATING REGIME IN TRICKLE-IRRIGATED FIELDS,
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 3F.
W89-04258

MODELING OF THE INFILTRATION PROCESS IN ARID ZONES FOR IRRIGATION PROJECT PURPOSES WITH THE AID OF THE 'SYSTEME HYDROLOGIQUE EUROPEEN' (SHE),
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France). Applied Mathematics Dept.
For primary bibliographic entry see Field 3F.
W89-04263

STOCHASTIC APPROACH OF SOIL WATER FLOW THROUGH THE USE OF SCALING FACTORS: MEASUREMENT AND SIMULATION,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
G. Vachaud, M. Vauclin, and P. Balabanis.

Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 249-261, June 1988. 7 fig, 1 tab, 20 ref.

Descriptors: *Simulation, *Stochastic hydrology, *Model studies, *Soil water, Scaling factors, Simulation analysis, Soil properties, Hydraulic conductivity.

A major problem met by hydrologists and soil physicists is related to the spatial variability of soil hydraulic properties. They must be used to describe water flow in the vadose zone, but they can exhibit a very large degree of spatial variations. A promising simplified method for describing spatial variability of these properties using the scaling technique is presented. Using this technique the following conclusions can be drawn: (1) Even if the conditions of similarity are not found in natural soil, it is possible to use normalization methods to scale soil water properties and to obtain a strong coalescence of the natural variability. (2) If the scaling factors are the same for both the hydraulic conductivity and the soil suction relationships, the similar-media theory can be extremely useful to predict hydraulic conductivity or pressure head in sites where measurements are not available and to develop stochastic solution of the equation of water flow in unsaturated soils which gives the expected values of the variables, together with its expected domain of uncertainty over the site. (White-Reimer-PTT)
W89-04267

VARIATION IN EVAPOTRANSPIRATION AND CAPILLARY RISE WITH CHANGING SOIL PROFILE CHARACTERISTICS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. W. Hopmans, and C. H. Van Immerzeel.
Agricultural Water Management AWMADF, Vol. 13, No.2-4 p 297-305, June 1988. 4 fig, 4 tab, 12 ref.

Descriptors: *Capillarity, *Soil profiles, *Soil water, *Soil-water-plant relationships, *Evapotranspiration, *The Netherlands, Model studies, Hydrologic models, Computer models, Soil water table, Hydraulic conductivity, Root zone, Soil horizons.

The prime agricultural lands in The Netherlands have relatively shallow watertables. Therefore, upward water flow from the watertable (capillary rise) can significantly contribute to the total plant water uptake. For this study, soil water characteristics and hydraulic conductivity function were determined in the laboratory for the surface and subsurface horizon at seven locations in a 0.5 ha field. These hydraulic functions served as input for the one-dimensional water flow model SWATRE, to investigate the influence of spatial variable soil hydraulic properties on evapotranspiration. The results of the computer simulation for the growing season in 1982 showed that at only one of the seven locations was there significant reduction in cumulative evapotranspiration due to dry conditions in the rootzone. Analysis of the simulations indicated that the degree of reduction in evapotranspiration was governed by the capacity of the subsoil to transport water from the groundwater to the rootzone. This conclusion is based on hydraulic conductivity measurements at only two depths per location. If more layers had been sampled, it is expected that the results would have been less conclusive, since the height of capillary rise is controlled by the least-conductive layer. (White-Reimer-PTT)
W89-04271

CHARACTERISTICS OF MOLE DRAINAGE AS A MAJOR AMELIORATIVE TECHNIQUE FOR SURFACE-WATERLOGGED SOILS,
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria). Dept. of Soil Physics.
For primary bibliographic entry see Field 3F.
W89-04272

EVALUATION OF VARIOUS COMPUTATIONAL SCHEMES IN CALCULATING UNSATURATED HYDRAULIC CONDUCTIVITY,
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
A. Poulovassilis, M. Polychronides, and P. Kerkides.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 317-327, June 1988. 8 fig, 15 ref.

Descriptors: *Soil water, *Hydraulic conductivity, *Mathematical analysis, *Aeration zone, Mathematical models, Soil profiles, Soil texture, Infiltration.

The application of the theory of soil water movement is most often hindered by a lack of knowledge of the fundamental soil water properties, that is, of the moisture characteristic and of the relationship between soil water content and hydraulic conductivity. This study compares K-theta or K-H relationships (where K is the hydraulic conductivity, theta the volumetric water content and H the soil water pressure head) calculated by means of four computational models proposed, with experimental ones determined in situ in a layered soil profile with textural profiles illustrated. In order to evaluate the effect of differences between experimental and computed relationships on soil water profile development, calculated profiles for the process of horizontal infiltration obtained by using both experimental and calculated K-theta relationships were compared. Also, cumulative infiltration versus time curves computed for the horizontal case by using both experimental and calculated K-theta relationships were compared to the same end. The differences between the computed and the experimental results constitute a measure of errors which could be introduced when computed conductivities are used for following water profile development. (White-Reimer-PTT)
W89-04273

DIELECTRIC TENSIOMETER,
Technical and Physical Engineering Research Service for Agriculture, Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W89-04280

EFFECT OF ACID RAIN ON PROPERTIES OF MOUNTAIN BROWN FOREST SOILS,
Akademiya Nauk SSSR, Vladivostok. Inst. of Pacific Ocean Geography.
For primary bibliographic entry see Field 5B.
W89-04282

SIMULATION OF SURFACE-MOISTURE EFFECTS ON THE GREAT PLAINS LOW-LEVEL JET,
Iowa State Univ., Ames. Dept. of Agronomy.
M. D. McCorcle.
Monthly Weather Review MRWEAB, Vol. 116, No. 9, p 1705-1720, September 1988. 15 fig, 28 ref.

Descriptors: *Model studies, *Mathematical models, *Weather patterns, *Precipitation, *Soil moisture, *Evaporation, *Soil hydrology, Convective precipitation, Boundary-layer models, Nocturnal jets, Vertical velocity fields, Great Plains.

Convective precipitation and severe weather episodes in the central United Stated commonly have diurnal oscillations with maximum amplitudes at night. Observations suggest that the timing of some convective events may be driven by diurnal changes in the atmospheric boundary-layer convergence and vertical-motion fields resulting from a nocturnal, low-level jet over the southern Great Plains. Recent planetary boundary-layer models have attempted to simulate the strong boundary-layer forcings and dissipations that may be partly responsible for these low-level flows. This research attempts to determine the effects of soil moisture and evaporation on the Great Plains nocturnal jet. Soil moisture determines surface evapotranspiration, latent heating, and soil thermal capacity and thereby plays an important role in the stratification and buoyancy of the boundary layer. Soil moisture should, therefore, be significant to this nocturnal, boundary-layer phenomenon. This hypothesis was evaluated by embedding a soil hydrology system in a boundary-layer numerical model. A springtime case of nocturnal convection was analyzed, and data from this period used to initialize the forecast model. Forecast experiments simulate well both nocturnal jets and vertical-velocity fields. The diurnal oscillations produced by the boundary-layer model are sensitive to surface moisture content and distribution. (Author's abstract)
W89-04283

EVALUATING THE EFFECT OF PUDDLING ON INFILTRATION USING THE GREEN AND AMPT EQUATION,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
G. D. Jennings, A. R. Jarrett, and J. R. Hoover.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 761-768, May-June 1988. 9 fig, 3 tab, 22 ref.

Descriptors: *Soil water, *Mathematical equations, *Rainfall, *Puddling, *Infiltration, Regression analysis, Permeability coefficient, Rainfall intensity, Soil surfaces, Numerical analysis, Soil texture, Soil types, Hydraulic conductivity, Soil suction.

After exposure to several different initial rainfall durations and rainfall sequences, the constant head cumulative infiltration of water into disturbed Hagerstown Silt loam Ap horizon soil samples of two aggregate sizes was measured. The Green-Ampt equation was fit to the cumulative infiltration data using nonlinear regression to yield hydraulic conductivity and capillary suction parameters for each treatment. The Green and Ampt equation fit the results of all treatments very well. The hydraulic conductivities and capillary suction values obtained were unique and characteristic of the flow process for all treatments containing a surface puddle or partial surface puddle caused by rainfall energy. These parameters were not unique for treatments which had no surface puddling. Surface puddling resulting from a sequence of rainfall events was also evaluated. It was found that the flow characteristics of the surface layer reflected the condition created as a result of the most recent rainfall event. Surface puddling from previous events was less important. (Author's abstract)
W89-04381

MECHANISMS BY WHICH SURGE IRRIGATION REDUCES FURROW INFILTRATION RATES IN A SILTY LOAM SOIL,
Agricultural Research Service, Kimberly, ID.
For primary bibliographic entry see Field 3F.
W89-04386

2H. Lakes

STRATEGIES AND DIFFICULTIES OF APPLYING MODELS TO AQUATIC POPULATIONS AND FOOD WEBS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7B.
W89-03355

MONITORING BIRD POPULATION DENSITIES ALONG THE COLORADO RIVER IN GRAND CANYON,
Glen Canyon Environmental Studies, Flagstaff, AZ.
For primary bibliographic entry see Field 6G.
W89-03379

POSTULATED WATER AVAILABILITY GRADIENT IN A COASTAL LANDSCAPE: AN ECOPHYSIOLOGICAL ANALYSIS,
New South Wales Univ., Kensington (Australia). School of Botany.
D. J. Anderson, P. Stricker, S. Williams, and P. Adam.
Functional Ecology, Vol. 2, No. 3, p 391-397, 1988. 4 fig, 4 tab, 18 ref.

Descriptors: *Plant physiology, *Available water, *Environmental gradient, *Ecological distribution, Coastal areas, Statistical analysis, Principal component analysis, Australia.

A principal-components analysis of floristic and associated environmental data from coastal heathland in southeastern Australia provided evidence for an axis of variation seemingly associated with a gradient of water availability. A collateral principal-component analysis of a range of water-relations parameters measured for a suite of woody species distributed along segments of the gradient strongly suggests that a majority of the sampled species exhibit some physiological adaptation to this gradient. (Author's abstract)
W89-03391

HIGH-RESOLUTION SAMPLER OF SURFACE PEAT,
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 7B.
W89-03392

210PB DATING OF LAKE SEDIMENTS AND OMBROTROPHIC PEATS BY GAMMA ASSAY,
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 7B.
W89-03398

SPECIATION OF PB-210/PO-210 IN AQUATIC SYSTEMS AND THEIR DEPOSITS,
Uppsala Univ. (Sweden). Dept. of Physics.
F. El-Daoushy, and R. Garcia-Tenorio.
Science of the Total Environment STENDL, Vol. 69, p 191-209, 1988. 4 fig, 1 tab, 27 ref. Spanish Research Fund contract CAICYT 2849/83.

Descriptors: *Geochemistry, *Lakes, *Fjords, *Lead radioisotopes, *Polonium radioisotopes, *Sediments, *Chemical speciation, Aquatic environment, Fulvic acids, Humic acids, Spectrophotometry, Acidity, Solubility, Lake sediments, Marine sediments, Peat, Radioactive dating.

This study was carried out on previously-examined deposits of known ages and geochemical histories. The main separated fractions were fulvic, humic, humin, and mineral-bonded humics. These organic components were wet-oxidized and their polonium-210 was extracted by coprecipitation with ferric ion, distillation at 450 C, and self-deposition on silver disks. Po-210 activity was determined by isotope-dilution and alpha-spectrometry techniques. Nineteen samples from lakes, fjords, and one ombrotrophic peat hummock were investigated. Humic materials proved to trap and preserve aquatic unsupported Pb 210, especially in lakes and peats. Fulvic compounds, on the other hand, seem to enhance the mobility of unsupported Pb 210, particularly under acidic conditions. However, the fulvic fraction of marine sediments showed higher amounts of unsupported Pb 210. The results showed that the supported Pb 210 is incorporated with the organo-mineral complexes, the NaOH-insoluble fraction. The Pb-210 activity of this fraction was found to converge to the expected supported Pb 210 of sediment samples older than 100 years or so; some younger sediments may show this, as well. This might serve as an alternative for evaluating the supported Pb 210 in Pb-210 dating. (Author's abstract)
W89-03400

BEAVER HABITAT USE AND IMPACT IN TRUCKEE RIVER BASIN, CALIFORNIA,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 2E.
W89-03429

ROLE OF STREAM SUBSTRATES IN ALUMINIUM MOBILITY AND ACID NEUTRALIZATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W89-03446

NUTRIENT UPTAKE AND RELEASE DURING GROWTH AND DECOMPOSITION OF EELGRASS, ZOSTERA MARINA L., AND ITS EFFECTS ON THE NUTRIENT DYNAMICS OF LAKE GREVELINGEN,
Rusthofstraat 13, 4337 KK Middelburg, The Netherlands.
For primary bibliographic entry see Field 2L.
W89-03461

OCCURRENCE OF SPHAGNUM MOSS IN THE SUBLITTORAL OF SEVERAL SMALL OLIGOTROPHIC LAKES IN GALLOWAY, SOUTHWEST SCOTLAND,
University Coll., London (England). Palaeoecology Research Unit.
P. J. Raven.
Aquatic Botany AQBODS, Vol. 30, No. 3, p 223-230, March 1988. 2 fig, 3 tab, 20 ref.

Descriptors: *Acidification, *Acid rain effects, *Macrophytes, *Mosses, *Scotland, *Acidic water, *Oligotrophic lakes, Chemical properties, Hydrogen ion concentration, Scandinavia, The Netherlands, Reforestation.

Comparison between historical and contemporary aquatic macrophyte data indicates that since 1905 Sphagnum has become established in the sublittoral of several oligotrophic lakes (lochs) in Galloway, southwest Scotland. This floristic change is broadly similar to that reported from some recently acidified lakes in Scandinavia and The Netherlands. It is possible that catchment afforestation and associated preparatory ploughing in particular, may encourage the establishment of sublittoral Sphagnum and consequently influence floristic changes in acidifying lakes. (Author's abstract)
W89-03462

RESPONSE OF AN ALASKAN WETLAND TO NUTRIENT ENRICHMENT,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5D.
W89-03463

INTERSTITIAL WATER PATTERNS: A FACTOR INFLUENCING THE DISTRIBUTIONS OF SOME LOTIC AQUATIC VASCULAR MACROPHYTES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
S. L. Fortner, and D. S. White.
Aquatic Botany AQBODS, Vol. 31, No. 1-2, p 1-12, July 1988. 3 fig, 2 tab, 34 ref.

Descriptors: *Interstitial water, *Macrophytes, *Aquatic plants, *Temperature effects, *Species composition, , *Lotic environment, Water temperature, Michigan, Groundwater movement, Streamflow, Soil water, Infiltration, Physicochemical properties.

The distributions of 9 species of aquatic vascular macrophytes were examined in relation to interstitial water patterns (based on temperature) in the beds of three northern Michigan streams. Ranunculus septentrionalis, Caltha palustris and Nasturtium officinale were associated with areas of groundwater discharge. Sparganium chlorocarpum, Veronica catenata, Potamogeton filiformis and P. richardsonii occurred most often at the downstream end of a hyporheic zone (corresponding to the foot of a riffle) where interstitial water was of surface origin. Sagittaria latifolia occurred where interstitial temperatures were cool; the water origin was not determined. Potamogeton gramineus occurred most often where interstitial temperatures were warm, primarily at the upstream ends and middles of hyporheic zones (heads of riffles in areas of surface-water infiltration. Complex patterns of interstitial water movement and related physicochemical complexity combined with differences in plant requirements, in part, may determine observed local distributions. (Author's abstract)
W89-03465

HUMMOCKING BY LOTIC CHARA: OBSERVATIONS ON ALTERATIONS OF HYPORHEIC TEMPERATURE PATTERNS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2E.
W89-03466

POPULATION TRENDS IN THE PHYTOPLANKTON AND ZOOPLANKTON OF THE UPPER AND MIDDLE ST. JOHNS RIVER, FLORIDA, 1983-1984,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W89-03468

MORPHOMETRIC AND BASIC LIMNOLOGICAL PROPERTIES OF THE LAGUNA DE RIO CUARTO, COSTA RICA,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
K. Gocke, W. Bussing, and J. Cortes.
Revista de Biologia Tropical RBTCAP, Vol. 35, No. 2, p 277-285, November 1987. 7 fig, 1 tab, 14 ref.

Descriptors: *Limnology, *Costa Rica, *Lake morphology, Lakes, Seasonal variation, Water temperature, Nutrients, Thermal stratification, Hypolimnion, Physicochemical properties.

The Laguna de Rio Cuarto, situated 360 m above sea level on the Caribbean side of the Cordillera Volcanica Central in Costa Rica, is a meromictic Maar. The water surface has an area of 33.24 ha, the maximum depth reaches 66 m and the mean depth 45.5 m. The lake volume is 15.12 million cu m. Seasonal variations of surface temperature have been observed between 26.4 and 29.9 C, whereas the temperature of the hypolimnion (at 60 m) fluctuates only between 24.2 and 24.4 C. The depth of the boundary layer between the oxic and the anoxic, H2S containing water body oscillates between 25 m (January/February) and 20 m (May/June). About 55% of the water body (mean value) is permanently anoxic. The vertical distribution of the nutrients, low concentrations in surface waters and high ones in deep waters, is related to the permanent stratification of the lake. (Author's abstract)
W89-03481

SECONDARY PRODUCTION AND ENERGY TRANSFER IN THE POLLUTED RIVER SAALE (THURINGIA, SOUTHERN GDR),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
For primary bibliographic entry see Field 5C.
W89-03494

REAERATION OF OXYGEN IN SHALLOW, MACROPHYTE RICH STREAMS: II. RELATIONSHIP BETWEEN THE REAERATION RATE COEFFICIENT AND HYDRAULIC PROPERTIES,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
N. Thyssen, and M. Erlandsen.
Internationale Revue der gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 5, p 575-597, 1987. 11 fig, 5 tab, 71 ref.

Descriptors: *Oxygen, *Dissolved oxygen, *Aeration, *Reaeration coefficient, *Air-water interfaces, *Macrophytes, Flow velocity, Streams, Aquatic plants, Hydraulic properties, Water temperature, Water depth, Slope, Regression analysis.

The rate coefficient K2 of the physical exchange of oxygen between flowing water and atmosphere is dependent on water temperature and the hydraulic variables: mean velocity of flow U, mean depth H, and slope S of the stream channel. Thirty-six equations from the literature predicting K2 on the basis of combinations of U, H and S were tested against 144 corresponding measurements of K2 and hydraulic variables taken in 10 reaches in 6 Danish streams with different development of the submerged macrophyte community. A statistical anal-

ysis showed that all equations except one had to be rejected. To improve predictive accuracy an equation was developed applying multiple linear regression. This equation allows K2 predictions for streams where the hydraulic variables U range from 0.06 to 0.52 m/s, H from 0.12 to 1.37 m and S from 0.0003 to 0.0074 m/m. Using this equation the lower and upper 95% limit of confidence for a given K2 prediction (K2p) are K2p/1.95 and K2p x 1.95, indicating that such equations at best approximate the real K2. Therefore K2 should preferably be measured. (See also W89-03493) (Author's abstract)
W89-03495

CHEMISTRY OF A TYPICAL DUTCH RESERVOIR, THE TJEUKEMEER, IN RELATION TO ITS WATER MANAGEMENT BETWEEN 1970 AND 1986,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, and J. Voerman.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 1-10, August 1988. 5 fig, 3 tab, 21 ref.

Descriptors: *Reservoirs, *Chemical properties, *Water management, *Water chemistry, *Water quality, *Water pollution sources, *Polders, Sodium, Chloride, Calcium, Potassium, Salinity, Alkalinity, Seasonal variation, Sulfates, Carbonates, Magnesium, Humic substances, Tjeukemeer, Rhine River, Netherlands.

The man-made hydrology of the Tjeukemeer is regulated by climate-dependent inlet of humic polder water and oligohaline water from Lake IJsselmeer, which is flushed by a branch of the river Rhine. Consequently, in summer Na and Cl and in winter Ca and alkalinity dominate the ionic balance. In winter the salinity is about half that in summer. Even though the ionic balances determined between 1970-86 were corrected for humic substances, 31% of them exhibited an excess of cations over anions exceeding 6%. Between 1970-77 the median annual sulfate concentration of the Tjeukemeer doubled to about 2 meq/L. The low sulfate deposition (48 mM/sq m/y = 0.06 meq/L) relative to the lake concentration, suggests that the Rhine was the sulfate source rather than atmospheric input. The quotient of the concentrations of Ca and total alkalinity was significantly related to the sulfate concentration. However, the ratio of this quotient and the sulfate concentration corrected for hydroxyl and carbonate ions deviated more than 35% from the theoretically expected value of 0.5 when CaSO4 is added to a solution supersaturated with CaCO3, as reported for the Rhine. During 1970-86 the median Cl concentrations of the Tjeukemeer, the IJsselmeer and the Rhine appeared to be significantly interrelated. In the very dry 1976 the ratio between the median Cl concentrations of the Tjeukemeer and the Rhine was 0.89, while in the wet 1985 this ratio was only 0.26. The relatively low median annual Cl concentration after 1982 indicates that the contribution of humic polder water to the lake chemistry has increased. Some algological implications of the management-dependent chemistry of the Tjeukemeer are briefly discussed. (Author's abstract)
W89-03497

DISTRIBUTION OF PLANKTONIC CILIATES IN HIGHLY COLOURED SUBTROPICAL LAKES: COMPARISON WITH CLEARWATER CILIATE COMMUNITIES AND THE CONTRIBUTION OF MYXOTROPHIC TAXA TO TOTAL AUTOTROPHIC BIOMASS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5C.
W89-03499

FLORISTIC CHANGES IN SHALLOW SOFT WATERS IN RELATION TO UNDERLYING ENVIRONMENTAL FACTORS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
G. H. P. Arts, and R. S. E. W. Leuven.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 97-111, August 1988. 3 fig, 7 tab, 51 ref. Ministry of Housing, Physical Planning and Environment, Directorates Air (projects LB 131 and L 1814054) and Water (project W 027/011642).

Descriptors: *Macrophytes, *Aquatic plants, *Lotic environment, *Water pollution effects, *Acid rain effects, Species composition, Hydrogen ion concentration, Alkalinity, Acidity, Heavy metals, Dissolved solids, Salts, Nutrients, Eutrophication, Hydrology, Netherlands.

Historical and recent data on the occurrence of macrophytes in 28 lentic soft waters in The Netherlands are summarized. These waters were, and a few still are, characterized by a submerged vegetation of isoetid plants. Changes in the species composition of macrophytes are visualized by means of multivariate analysis and by shifts in species-spectra. Ordination of the available data shows that the pH, alkalinity, acidity, contents of heavy metals, dissolved organic matter and some important salts and nutrients in water and interstitial water are strongly related to the recent distribution of aquatic plants in waters which were originally of low alkalinity. In addition, the available inorganic carbon and the redox potential in the sediment are also important environmental parameters in explaining differences in aquatic vegetation. The recorded changes in the macrophyte species composition can be attributed to the effects of acidification and eutrophication. The most important overall change is a reduction of the number of species. Hydrology proves to be important in controlling the sensitivity of a body of water for acidifying deposition. (Author's abstract)
W89-03500

INEXPENSIVE DEVICE FOR SAMPLING LARGE VOLUMES OF LAKE WATER FROM DISCRETE DEPTHS,
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W89-03501

COMPARISON OF ZOOPLANKTON PRODUCTION ESTIMATES OBTAINED FROM THREE COMMONLY USED METHODS AND A COMPUTER SIMULATION PROGRAM,
C. R. King.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 117-126, August 1988. 2 fig, 1 tab, 40 ref.

Descriptors: *Zooplankton, *Eutrophic lakes, *Aquatic productivity, *Reservoirs, *Biomass, Computer models, Model studies.

Zooplankton production in a eutrophic reservoir was estimated by three common methods. Estimates of daily production from the growth increment method and the birth and death rate versions of the biomass turnover method were poorly correlated (r=0.58-0.60). Estimates of daily production rates from the two versions of the biomass turnover method were strongly correlated (r=0.90). The mortality rate version of the biomass turnover method is illogical and yields anomalous results. The growth increment method assumes steady state conditions and zero deaths within each stage and hence calculates potential production for each stage. Estimates from a new computer simulation (PROD) were strongly correlated with (r=0.92) but lower than those from the growth increment method. Estimates from PROD were more poorly correlated (r=0.78) with those from the biomass turnover method. There is a strong need for improved methods for estimating secondary production; computer based methods would seem to be the most promising. (Author's abstract)
W89-03502

NITROGEN UPTAKE IN THE PHYTOPLANKTON OF OSLOFJORDEN, NORWAY: EFFECTS OF ENVIRONMENTAL AND BIOLOGICAL COVARIATES,
Oslo Univ. (Norway). Dept. of Biology.
A. Tobiesen.
Sarsia SARIA3, Vol. 72, No. 3/4, p 299-311, 1987. 6 fig, 5 tab, 59 ref.

Descriptors: *Phytoplankton, *Nutrients, *Nitrogen, *Ammonium, *Nitrates, *Fjords, Light intensity, Water temperature, Water depth, Salinity, Biological properties, Chemical properties, Chlorophyll a, Biomass, Seasonal variation, Oslofjorden, Norway.

The uptake rates of nitrate and ammonium at 6 depths at one station in Oslofjorden were measured on 11 dates by the nitrogen-15 isotope method. Other measured variables were nitrate and ammonium concentration, light extinction and irradiance, temperature, salinity, phytoplankton composition and biomass, mean cell volume, chlorophyll a, and particulate N. Ammonium was the more important N-nutrient in the summer at 0, 2, and 4 m depths, while nitrate was the dominant N-nutrient at 6, 8, and 16 m depths and in the winter. There was no clear indication of N-limitation on any of the sampling dates. Statistical analysis showed that physical and chemical variables were more important than biological ones in explaining N-uptake. Temperature was the most significant covariate. Depth was a better indicator of vertical variation than light extinction. Day-length was an important factor when N-uptake was normalized to chlorophyll a. (Author's abstract)
W89-03510

INUNDATED TIMBER AS NURSERY HABITAT FOR LARVAL GIZZARD AND THREADFIN SHAD IN A NEW PUMPED STORAGE RESERVOIR,
Georgia Cooperative Fishery and Wildlife Research Unit, Athens.
For primary bibliographic entry see Field 8I.
W89-03528

EFFECT OF AGRICULTURE ON THE PRIMARY PRODUCTION IN LAKE BESKIE (POLAND) AS RECORDED IN THE STRATIGRAPHY OF FOSSIL PIGMENTS,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
For primary bibliographic entry see Field 5C.
W89-03540

WITHIN- AND AMONG-LAKE VARIATION IN SHELL MORPHOLOGY OF THE FRESHWATER CLAM ELLIPTIO COMPLANATA (BIVALVIA: UNIONIDAE) FROM SOUTH-CENTRAL ONTARIO LAKES,
University of Western Ontario, London. Dept. of Zoology.
S. G. Hinch, and R. C. Bailey.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 27-32, January 8, 1988. 4 fig, 4 tab, 17 ref.

Descriptors: *Limnology, *Lakes, *Alkalinity, *Clams, *Morphology, *Ontario, Wave action, Growth rates, Statistical analysis, Analysis of variance, Correlation analysis, Bioindicators, Sampling.

To compare the relative magnitude of variation, Elliptio complanata were collected from low and high exposure areas in each of four small lakes. It has been suggested that variation in alkalinity can cause variation in shell shape and growth rate. To help assess the importance of within-lake variation in shell morphology due to exposure, we compared within-lake variation to among-lake variation due to alkalinity. Nested analyses of variance on shell length, height, width, and weight revealed that shell morphology varied much more between sites of differing exposure within a lake than among lakes of differing alkalinity. Canonical variates analysis showed that clams from high-exposure areas had larger and proportionately taller and heavier shells than those from low-exposure areas. There was no relationship between alkalinity of lakes and shell morphology. These results suggest that the use of unionid shell morphology to predict long-term whole-lake water chemistry (e.g., alkalinity) requires sampling designs which take into account within-lake variation in shell morphology. (Author's abstract)
W89-03541

DYNAMICS OF DISSOLVED ORGANIC NITROGEN IN SUBALPINE CASTLE LAKE, CALIFORNIA,
California Univ., Davis. Div. of Environmental Studies.
J. P. Zehr, S. G. Paulsen, R. P. Axler, and C. R. Goldman.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 33-45, January 8, 1988. 5 fig, 1 tab, 55 ref. NSF grant BSR-8019918.

Descriptors: *Limnology, *Castle Lake, *Mountain lakes, *Dissolved solids, *Nitrogen compounds, *Nitrogen cycle, *California, Mesotrophic lakes, Oligotrophic lakes, Primary productivity, Chlorophyll, Lake sediments, Amino acids.

Dissolved organic nitrogen (DON) concentrations were measured in a meso-oligotrophic lake during the ice-free season in 1982, 1983, and 1984. No consistent relationships were found between DON and particulate N, primary productivity rates, or chlorophyll concentrations. However, increases in DON concentrations were observed in the early growing season of 1982 and 1984 when water temperature was rising and a diatom bloom was senescing. DON increased at a high rate (0.31 mg atom N/cubic m/day), and then rapidly disappeared. Sediment release appeared to be the most important source of DON. Dissolved free amino acids were always less than 7.5% of the DON pool, and did not vary in the composition of specific amino acids during the growing season. (Author's abstract)
W89-03542

SOME LIMNOLOGICAL OBSERVATIONS ON TWO ETHIOPIAN HYDROELECTRIC RESERVOIRS: KOKA (SHEWA ADMINISTRATIVE DISTRICT) AND FINCHAA (WELEGA ADMINISTRATIVE DISTRICT),
Addis Ababa Univ. (Ethiopia). Dept. of Biology.
M. Mesfin, C. Tudorancea, and R. M. Baxter.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 47-55, January 8, 1988. 6 fig, 5 tab, 23 ref.

Descriptors: *Limnology, *Reservoirs, *Benthos, *Plankton, *Ethiopia, Dam effects, Turbidity, Suspended solids, Supersaturation, Oxygen depletion, Conductivity, Microcystis, Species diversity, Decomposing organic matter, Acidic water, Calcium, Hydroelectric plants.

Koka Reservoir in the Ethiopian Rift Valley (altitude about 1600 m) appears to be similar to natural lakes in the region. Its water is turbid because of suspended inorganic material. At the time of measurement it was supersaturated with oxygen to a depth of about 8 m, and displayed a pronounced conductivity stratification, due probably to the incomplete mixing of two inflows. The phytoplankton was dominated by Microcystis. The zooplankton was of low diversity but abundant. There was a large population of benthic invertebrates. Finchaa Reservoir in west-central Ethiopia (altitude about 2200 m) is very different. It covers the former Ch'omen Swamp and so contains many floating islands and large quantities of decomposing vegetation, causing undersaturation with oxygen even at the surface. The water is somewhat turbid owing to the presence of organic debris, of low conductivity, slightly acidic, and apparently calcium-dominated. A species of Microcystis was the most abundant phytoplankter. The zooplankton was sparse and of very low diversity. There were almost no benthic invertebrates. (Author's abstract)
W89-03543

FLUCTUATION OF ALGAL ALKALINE PHOSPHATASE ACTIVITY AND THE POSSIBLE MECHANISMS OF HYDROLYSIS OF DISSOLVED ORGANIC PHOSPHORUS IN LAKE BARATO,
Hokkaido Research Inst. for Environmental Pollution, Sapporo (Japan). Div. of Water Environment.
S. Hino.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 77-84, January 8, 1988. 2 fig, 4 tab, 27 ref.

Descriptors: *Limnology, *Lakes, *Dissolved solids, *Phosphorus compounds, *Enzymes, *Algae, Hydrolysis, Chlorophyll a, Diatoms, Cyanophyta, Melosira, Anabaena, Escherichia coli, Lake sediments, Japan.

Fluctuation of phosphatase activity and phosphatase hydrolysis of phosphorus were investigated from April 1983 to February 1984 in a lake in central Hokkaido, Japan. Throughout the year, the total alkaline phosphatase activity tended to change at the same time as the concentration of chlorophyll a. By contrast, the specific enzymatic activity declined in summer in spite of high concentrations of chlorophyll a. The dominant phytoplankton changed from diatoms to blue-green algae in the late spring and early summer, and changed again to diatoms in autumn. These results indicate that the decline in enzyme activity in summer is due to phytoplankton succession rather than to external concentrations of inorganic and dissolved organic phosphorus. Three variants of alkaline phosphatase were purified from Melosira spp., Anabaena sp., and Escherichia coli. Most (more than 74%) of the organic phosphorus extracted from phytoplankton was hydrolyzed by these three phosphatases. By contrast, the organic phosphorus in lake water and that extracted from sediments were only partially hydrolyzed (up to 32% and 20%, respectively) by the same enzymes. These results indicate that phytoplankton cannot utilize most of the dissolved organic phosphorus in the lake water or in the sediments through enzymatic hydrolysis by alkaline phosphatase, in spite of the high levels of activity of this enzyme in the organisms. (Shidler-PTT)
W89-03544

BIRCH LEAF PROCESSING AND ASSOCIATED MACROINVERTEBRATES IN AN ACIDIFIED LAKE SUBJECTED TO LIMING,
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 5G.
W89-03545

ZOOPLANKTON OF A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND): SEASONAL CHANGES AND THE INFLUENCE OF WATER QUALITY MANAGEMENT MEASURES,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
P. R. Hawkins.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 105-118, January 18, 1988. 6 fig, 2 tab, 37 ref.

Descriptors: *Aeration, *Limnology, *Reservoirs, *Water quality management, *Zooplankton, *Tropical regions, Waterfleas, Rotifers, Copepods, Cyanophyta, Species composition, Flushing, Australia.

The Solomon Dam is situated on Palm Island, a continental island of 240 square km, about 15 nautical miles from the east Australian coast. Seasonal changes in the density and taxonomic composition of the zooplankton of this small tropical impoundment were examined in relation to factors of water temperature, food supply, and reservoir flushing. Cyclopoid copepods were the dominant zooplankters, although Cladocera became much more significant following the introduction of measures to control cyanobacteria. Planktonic Rotifera were a diverse but generally unimportant fraction of the total biomass, except following seasonal or management-induced environmental perturbations, when the Rotifera often recovered most rapidly. Water temperature, flushing rates, and the phytoplankton species composition were all factors which influenced zooplankton abundance and the structure of the assemblage. The abiotic factors of flushing and thermal tolerance both contributed to an annual periodicity in the zooplankton. The influence of artificial aeration in suppressing the growth of filamentous cyanobacteria probably contributed to the increased abundance and diversity of the cladoceran fauna. Opportunistic colonization by the rotiferan fauna with the capacity to adapt and reproduce rapidly following abiotic perturbations was also a feature of the Soloman Dam zooplankton. (Shidler-PTT)
W89-03546

FIELD OBSERVATIONS ON THE INFLUENCE OF LOW WATER VELOCITIES ON DRIFTING OF BULINUS GLOBOSUS,
Institut Tropical Suisse, Ifakara (Tanzania). Field Lab.
H. P. Marti, and M. Tanner.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 119-123, January 18, 1988. 3 fig, 14 ref.

Descriptors: *Stream biota, *Snails, *Parasitesm, *Human diseases, *Flow velocity, *Water quality management, Infection, Aquatic populations, Animal behavior, Vegetation effects, Water currents, Migration, Tanzania, Public health.

A better understanding of the influence of low water velocities on populations of the snail Bulinus globosus, a vector in the transmission of urinary schistosomiasis, is desirable. It would allow better planning of control measures directed against the snails in situations where transmission occurs in slow-flowing water systems. Consequently, a study, aimed at an evaluation of the role of low (less than 30 cm/s) water velocity on snail drifting, was undertaken in a small stream some 350 km SW of Dar es Salaam, Tanzania, in an area well known to be endemic for Schistosoma haematobium. It was shown that although a low water velocity did not sweep away adhering snails, it carried away snails releasing their hold and crawling along the water surface in search of new food sources. A low water velocity therefore assisted considerably in the spreading of the snails. Vegetation had decisive impact on local water-velocity conditions by reducing the current and creating protected pockets. Upstream migration was not common among Bulinus globosus. (Shidler-PTT)
W89-03547

GROWTH IN A FRESHWATER SNAIL UNDER LABORATORY CONDITIONS IN RELATION TO EUTROPHICATION,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W89-03548

NUISANCE BIOMASS LEVELS OF PERIPHYTIC ALGAE IN STREAMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-03549

WATER HYACINTH PRODUCTIVITY AND DETRITUS ACCUMULATION,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. K. Moorhead, K. R. Reddy, and D. A. Graetz.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 179-185, January 18, 1988. 3 fig, 3 tab, 12 ref.

Descriptors: *Aquatic plants, *Water hyacinths, *Eutrophication, *Aquatic productivity, *Detritus, Nitrogen cycle, Nitrogen removal, Nutrients, Fertilization, Reservoirs, Seasonal variation, Statistical analysis, Florida.

The objectives of this study were (1) to determine net productivity and detritus accumulation of water hyacinths (Eichhornia crassipes) grown in eutrophic lake water with and without added nutrients and (2) to determine the potential of detritus as a nutrient source or sink. The study was conducted in two 60-cm deep by 7.6 m by 61 m reservoirs located in central Florida. One reservoir was fertilized by broadcasting a granular 10-4-10 fertilizer to add 100 kg nitrogen/ha monthly for the first 5 months, and 50 kg N/ha for the next 7 months. Seasonal changes were determined at monthly intervals for one year. Significant differences were observed in productivity between seasons and nutrient additions. Seasonal plant productivity ranged from 1.9 to 23.1 mg (dry wt)/ha for the fertilized reservoir and -0.2 to 10.2 mg/ha for the control reservoir. Detritus accumulation was not significantly different between seasons or nutrient additions. Seasonal N assimilation by plants ranged from 34 to 242 kg N/ha for plants in the

fertilized reservoir and <0 to 104 kg N/ha for plants in the control reservoir. Annual net N recovered in detritus represented 21 and 28% of the total N removed by plants in the fertilized and control reservoirs. Net N loading to the reservoirs from detritus was 92 to 148 kg N/ha/yr. (Shidler-PTT)
W89-03550

LIFE HISTORIES, ABUNDANCE AND DISTRIBUTION OF SOME MACROINVERTEBRATES FROM A SOUTH CAROLINA, USA COASTAL PLAIN STREAM,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
L. A. Smock.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 193-208, January 22, 1988. 10 fig, 38 ref. National Park Service contract CX 5000N0-0946.

Descriptors: *Stream biota, *Baseline studies, *Life history studies, *Macroinvertebrates, *Aquatic insects, *Animal populations, *Coastal plains, *South Carolina, Secondary productivity, Beetles, Mayflies, Caddisflies, Dragonflies, Alderflies, Blackflies, Isopods, Ecological distribution.

The most abundant macroinvertebrates, exclusive of chironomids and oligochaetes, were studied in Cedar Creek, a low-gradient, second-order, blackwater stream. Besides being of inherent interest to the biology and ecology of these species, this life-history information is necessary for macroinvertebrate secondary-production estimates, the development of energy budgets for streams, and for environmental-impact assessment. Univoltine life histories were found for all species of Coleoptera and most species of Ephemeroptera, although the mayfly Stenonema modestum was at least bivoltine. Both univoltinism, partial bivoltinism and complete bivoltinism were found among the Trichoptera. Odonate species were both univoltine and semivoltine. The alderfly Sialis aequalis and the isopod Asellus laticaudatus were univoltine, while the blackfly Simulium taxodium produced at least 6 generations per year. Groups of functionally-related species within the orders Odonata, Trichoptera, and Coleoptera each exhibited possible temporal and/or spatial segregation. The life histories reported here are similar to those reported for the same or closely-related species from the warm-water streams and rivers of the southeastern United States. While there is a general similarity in the life history of the Cedar Creek population of a given species with that of populations from streams in colder climates, the specific timing of such events as egg hatching, pupation, and emergence often differ. (Shidler-PTT)
W89-03551

COMPARISON OF SULFUR CONCENTRATIONS WITHIN LAKE SEDIMENT PROFILES,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 5B.
W89-03552

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W89-03553

CHANGES IN THE ABUNDANCE OF BLUE-GREEN ALGAE RELATED TO NUTRIENT LOADINGS IN THE NEARSHORE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W89-03555

DIRECT AND INDIRECT INFLUENCES OF CRUSTACEAN ZOOPLANKTON ON BACTERIOPLANKTON OF LAKE CONSTANCE,
Staatliches Inst. fuer Seenforschung und Fischereiwesen, Langenargen (Germany, F.R.).
H. Gude.
Hydrobiologia HYDRB8, Vol. 159, No. 1, p 63-73, March 8, 1988. 4 fig, 2 tab, 54 ref.

Descriptors: *Limnology, *Lakes, *Plankton, *Crustaceans, *Bacteria, *Food habits, Aquatic populations, Population density, Species composition, Growth, Waterfleas, Algae, Flagellates, Organic carbon, Aquatic productivity.

Herbivorous crustacean zooplankton may influence bacterial populations of lakes directly by grazing on them or indirectly by grazing on algae. In Lake Constance a regularly-observed decrease of bacterial density during periods of high abundance of cladocerans indicated bacterial grazing losses. However, cladoceran grazing on bacteria appeared to be less efficient than on algae. Moreover, cladocera reduced grazing pressure on bacteria by grazing on bacterivorous flagellates. Additionally, a shift of bacterial composition from an originally-higher percentage of filamentous and aggregate growth forms towards a population of homogeneously-distributed small single-celled bacteria was observed annually. Transient increases of bacterial abundance and productivity coinciding with the increase of cladocera at the end of the algal spring bloom were interpreted as field indications of indirect bacteria/zooplankton interactions due to crustacean grazing on phytoplankton. The release of organic carbon during grazing of crustacea on algae was considered as explanation for the observed stimulation of bacterial populations. Thereby, additional, otherwise-inaccessible algal carbon would be made available to bacteria by zooplankton. Experimental support for this hypothesis was given by showing that bacteria were able to respond to crustacean grazing on algae by enhanced growth and activities. (Author's abstract)
W89-03556

EXPERIMENTAL STUDIES ON SOME FACTORS INFLUENCING PHOSPHORUS SOLUBILIZATION IN CONNEXION WITH THE DRAWDOWN OF A RESERVOIR,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
A. Fabre.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 153-158, March 15, 1988. 3 fig, 1 tab, 24 ref.

Descriptors: *Dam effects, *Water pollution sources, *Reservoirs, *Drawdown, *Phosphorus, *Cycling nutrients, *Solubility, Sediments, Suspension, Pyrenees Mountains, France, Drying, Mixing, Turbidity, Orthophosphates, Influent streams, Hydrogen ion concentration.

The periodic drawdown of reservoirs affects the phosphorus cycle. During dry periods sediments are in immediate contact with the atmosphere, then part of them are resuspended when the water rises again. Experimental studies on sediments of the Puyvalodor reservoir (Pyrenees, France), which is subjected to a considerable drawdown every year, showed that the quantity of phosphorus dissolved after sediment resuspension varied according to the speed with which the water rises, the preceding desiccation of the sediments, and the origin of the water used in the experiments. An increased refilling rate resulted in decreased phosphorus redissolution. The intensity with which the sediments were stirred depended on the refilling rate. In the experiment a far stronger turbidity was noted when the water was added in three steps rather than all at once. Sediments subjected to desiccation by air at 15 C for a week yielded more orthophosphate than those used as collected. The observed differences related to the origin of the water were attributed to differences in the influent streams' initial orthophosphate content and pH. Less orthophosphate was released into water with an already-high orthophosphate content whereas higher pH correlated with higher orthophosphate redissolution. These drawdown-related variables must be taken into account when studying the solubilization of phosphorus in reservoirs. (Author's abstract)
W89-03557

SEASONAL CHANGES IN SEDIMENT AND WATER CHEMISTRY OF A SUBTROPICAL SHALLOW EUTROPHIC LAKE,
Central Florida Research and Education Center, Sanford, FL.
A. Ali, K. R. Reddy, and W. F. DeBusk.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 159-167, March 15, 1988. 6 fig, 5 tab, 19 ref.

Descriptors: *Eutrophication, *Hydrologic data collections, *Eutrophic lakes, *Lake sediments, *Shallow water, *Subtropic zone, *Florida, Chemical properties, Seasonal variation, Dissolved solids, Conductivity, Flushing, Precipitation, Nitrogen, Phosphorus, Organic matter, Organic carbon.

A field study was conducted (May 1981 to June 1982) to develop a database on Lake Monroe (4000 ha surface and ca. 2 m deep), a part of the St. Johns River located in central Florida. Quantitative samples of lake water and sediments were collected monthly from 16 stations and analyzed for various physico-chemical parameters. Relatively-high levels of dissolved solids (mean electrical conductivity (EC) = 1832 microS/cm) prevailed in the lake water, and seasonal changes in EC were probably associated with hydrologic flushing from external sources, such as incoming water from upstream as well as precipitation. Average monthly levels of total nitrogen and phosphorus during the study period were 1.82 and 0.21 mg/l. Nutrient concentrations in the water did not show any strong seasonal trends. Organic-matter content of the lake sediments ranged from 1 to 182 g carbon/kg of dry sediment, reflecting considerable spatial variability. All nutrient elements in the sediments showed highly-significant ($P < 0.01$) correlations with sediment organic C, though little or no significant relationship appeared at any sampling period between water and sediment chemistry of the lake. Temporal trends in water and sediment chemical parameters may have been concealed by periodic hydrologic flushing of the St. Johns River into Lake Monroe. (Author's abstract)
W89-03558

DEGRADATION OF SOFTWOOD (14C LIGNIN) LIGNOCELLULOSES AND ITS RELATION TO THE FORMATION OF HUMIC SUBSTANCES IN RIVER AND POND ENVIRONMENTS,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
E. Fustec, E. Chauvet, G. Gas, D. Lacaze, and M. Escautier.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 169-176, March 15, 1988. 2 fig, 4 tab, 32 ref.

Descriptors: *Detritus, *Garonne River, *Rivers, *Ponds, *Degradation, *Softwood, *Carbon radioisotopes, Lignocelluloses, Humic substances, France, Mineralization, Running waters, Standing waters, Sediments, Oxygen supply, Carbon dioxide, Organic carbon.

The fate of lignin in water and sediment of the Garonne River (France) and of a pond in its floodplain was examined using specifically-labeled lignocelluloses. No significant differences appeared in the mineralization rate of C-14-labeled lignin in alder, poplar, or willow in running-water samples. Conversion of total radioactivity to C-14-labeled carbon dioxide ranged between 18.7% and 24.4% after 120 days of incubation. The degree of C-14-labeled-lignin mineralization in standing water and sediments was clearly lower, especially in submerged sediments, and was correlated with oxygen supply. After 60 days of incubation 3.3% to 7.9% of the C-14-labeled lignin was recovered in water samples as dissolved organic carbon originating from microbial metabolism. In water extracts from sediment the percentage of dissolved organic C 14 was only 0.4% to 1.3% of the applied activity. In the humic fraction extracted from sediments it did not exceed 4.4% which was much lower than in soils. No significant difference appeared between river and pond conditions for humic-substances formation. (Author's abstract)
W89-03559

NITROGEN DYNAMICS IN A EUTROPHIC LAKE SEDIMENT,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. R. Reddy, R. E. Jessup, and P. S. C. Rao.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 177-188, March 15, 1988. 4 fig, 5 tab, 26 ref.

Descriptors: *Eutrophic lakes, *Lake sediments, *Nitrogen, *Nitrogen cycle, *Lake restoration, *Florida, Lake Apopka, Shallow water, Water hyacinth, Isotope studies, Ammonium, Absorption, Interstitial water, Simulation, Nutrients, Nitrogen compounds.

Nitrogen flux from sediment of Lake Apopka, a shallow central Florida lake, and subsequent utilization by the water hyacinth (Eichhornia crassipes) were evaluated using an outdoor-microcosm sediment/water column. Sediment N was enriched with N15 to quantitatively determine the movement of ammonium N from the sediment to the overlying water column. During the first 30 days, 48% of the total N uptake by water hyacinth was derived from sediment N15-labeled ammonium N. This had decreased to 14% after 183 days. Mass balance of N indicates that about 25% of sediment ammonium N was released into the overlying water, but only 17% was assimilated by water hyacinths. Ammonium-N levels in the water column were very low, with little or no concentration gradients. Ammonium-N levels in the interstitial water of the sediment were in the range of 30-35 mg/L for the lower depths (>35 cm), while in the surface 5 cm of depth ammonium-N levels decreased to 3.2 mg/L. Simulated results also showed similar trends for the interstitial ammonium-N concentration of the sediment. The overall estimated ammonium-N flux from the sediment to the overlying water was 4.8 microg/square cm/day, and the soluble organic-N flux was 5.8 microg N/square cm/day. Total N flux was 10.6 microg N/square cm/day. (Author's abstract)
W89-03560

EFFECTS OF MINERAL TURBIDITY ON FRESHWATER PLANKTON COMMUNITIES: THREE EXPLORATORY TANK EXPERIMENTS OF FACTORIAL DESIGN,
Oklahoma Univ., Kingston. Biological Station.
S. T. Threlkeld, and D. M. Soballe.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 223-236, March 22, 1988. 7 fig, 4 tab, 28 ref. NSF grants BSR 8206865 and BSR 8315127.

Descriptors: *Reservoirs, *Limnology, *Plankton, *Turbidity, *Minerals, Experimental design, Bentonite, Kaolin, Silica, Oklahoma, Texas, Fish, Nutrients.

Three experiments were conducted in 18 7000-L tanks containing plankton derived from Lake Texoma (Oklahoma/Texas), a large reservoir often subject to turbid inflows. Replicate plankton communities developed for 30-45 d in response to 4-9 treatments of planktivorous fish, dead fish, nutrient additions, and artificial removal of zooplankton with plankton netting (or combinations of these manipulations). In one experiment three concentrations of kaolin were then added and in the other two experiments bentonite or powdered silica were added. The responses of the diverse plankton communities to the addition of mineral turbidity were measured for an additional period of 30-45 d. Effects of introduced minerals (quality or concentration effects) and food-web treatments after mineral addition (fish, nutrients, etc.) were determined by analysis of covariance, resulting in a statistical model explaining >80% of the variance for most response variables. The values of response variables at the time of mineral addition were often the most important source of variation, suggesting the importance of biotic community resiliency to the effects of mineral turbidity. There were few effects of mineral particles on physical or chemical (temperature, conductivity, oxygen, pH), nutrient (nitrate, phosphate, alkalinity) or biotic (algal or zooplankton populations) components of the tank communities. (Author's abstract)
W89-03564

EFFECTS OF PERMETHRIN ON PHYTOPLANKTON AND ZOOPLANKTON IN AN ENCLOSURE ECOSYSTEM IN A POND,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 5C.
W89-03566

EVALUATION OF INDICATORS OF NITROGEN LIMITATION IN DEEP PRAIRIE LAKES WITH LABORATORY BIOASSAYS AND LIMNOCORRALS.
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, and A. M. Trimbee.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 269-276, March 22, 1988. 3 fig, 3 tab, 27 ref.

Descriptors: *Lakes, *Nitrogen, *Bioassay, *Mesocosms, *Cyanophyta, Canada, Euphotic zone, Limiting nutrients, Enrichment, Phosphorus, Biomass, Epilimnion.

The deep lakes in central Alberta are characterized by relatively-high total nitrogen (TN) to total phosphorus (TP) ratios (33 to 64, by weight) and high TP (10 to 100 microg/L) in the euphotic zone in summer. These same lakes show indications of nitrogen limitation--(1) blue-green algae are relatively important in summer (7 to 88% of total biomass) and a large proportion of the filaments contain heterocysts and (2) inorganic nitrogen levels are extremely low in the surface waters (nitrite plus nitrate plus ammonium minus N is less than 10 microg/L). In 1985 and 1986 inorganic nitrogen (25 to 1200 microg/l minus N) and/or phosphorus (12 to 100 microg/L minus P) was added to water in 31-cu-m limnocorrals or 2-l bottles from four deep prairie lakes. In most cases, phytoplankton biomass (estimated as chlorophyll a) was stimulated only by phosphorus additions. However, for 8 days after an unusually rainy 6-day period, phytoplankton biomass was stimulated by nitrogen additions. After this storm, TP increased by up to 75% in the epilimnion of the study lakes whereas TN did not increase. The algae which increased in these experiments tended to be the dominant algae in the control vessels, which varied with the experiment and the lake. Thus, a large proportion of blue-green algae and low inorganic-nitrogen levels are not indicative per se of nitrogen limitation in lakes. (Author's abstract)
W89-03568

CASCADING TROPHIC INTERACTIONS: UNCOUPLING AT THE ZOOPLANKTON-PHYTOPLANKTON LINK,
York Univ., Toronto (Ontario). Dept. of Biology.
D. J. McQueen, and J. R. Post.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 277-296, March 22, 1988. 17 fig, 7 tab, 49 ref.

Descriptors: *Limnology, *Food chains, *Zooplankton, *Phytoplankton, *Mesocosms, Fish, Crustaceans, Daphnia, Population density, Transparency, Algae, Biomass, Diets, Eutrophication, Algae, Population dynamics, Perch.

Four limnocorrals were used to examine the interactions between planktivorous fish, crustacean zooplankton, and phytoplankton. As the summer progressed, the relationship between Daphnia biomass and phytoplankton abundance became more complex and less predictable. Investigation of these interactions suggested four conclusions. (1) During late July and throughout August and September, water transparency decreased and algal-cell counts increased. Decreased transparency was associated with increased concentrations of algae that were poor food sources for Daphnia. These results suggested that decreased water transparency was not caused by decreases in Daphnia biomass. (2) There was no correlation between the magnitude of July Daphnia biomasses and the percentage of 'poor-food-source' algae that were observed in August. This suggested that grazer effects were not necessary for the onset of summer poor-food-source algal blooms. (3) There was no correlation between decreased Daphnia reproductive capacity and poor-food-source blooms. These data suggested that blooms of poor-food-source algae were not necessary for the collapse of Daphnia populations. (4) There was a strong correlation between the time that 0+ yellow-perch planktivores reached biomasses of 30-50 kg/ha and the collapse of Daphnia populations. These results suggested that these fish biomasses caused the Daphnia population collapse. (Author's abstract)
W89-03569

CAN RESULTS FROM LIMNOCORRAL EXPERIMENTS BE TRANSFERRED TO IN SITU CONDITIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Bloesch, P. Bossard, H. Buhrer, H. R. Burgi, and U. Uehlinger.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 297-309, March 22, 1988. 2 fig, 6 tab, 53 ref.

Descriptors: *Limnology, *Mesocosms, *Experimental design, *In situ tests, *Lake Lucerne, *Crustaceans, Switzerland, Plankton, Seston, Cycling nutrients, Eddy diffusion, Reproducibility, Particulate matter.

In 1982-1984 eight limnocorral (LC) experiments, each lasting for two weeks, were performed in mesotrophic Lake Lucerne, Switzerland, to study the effects of removal of crustaceans by 95-micron filter nets on zooplankton/phytoplankton relationships and epilimnetic carbon and phosphorus fluxes. Seston concentrations and, to a lesser extent, primary-production rates were reduced in control LCs through zooplankton grazing, and settling flux increased through fecal-pellet production. But C and P regeneration were not significantly affected. Several indications were found that the LCs, despite their large size (about 70 cu m), were artificial systems when compared to the surrounding lake: Eddy diffusion was diminished by about one order of magnitude, nutrients were depleted, phytoplankton and zooplankton showed lower standing crops in the control LCs than in the lake, phytoplankton showed a shift from nannoplankton to netplankton, crustacean zooplankton were limited in their vertical migration, and particulate organic-C and particulate-P sedimentation rates were increased. Problems of the LC technique include replicability, scaling (size and time), and data extrapolation. The impact of crustacean zooplankton on particulate matter, i.e., seston reduction and sedimentation enhancement, could be extrapolated on a qualitative, but not on a quantitative, basis for the Lake Lucerne ecosystem. (Author's abstract)
W89-03570

PHOSPHORUS BIOAVAILABILITY OF FLUVIAL SEDIMENTS DETERMINED BY ALGAL ASSAYS,
Montana Univ., Polson. Flathead Lake Biological Station.
B. K. Ellis, and J. A. Stanford.
Hydrobiologia HYDRB8, Vol. 160, No. 1, p 9-18, March 8, 1988. 3, fig, 4 tab, 27 ref. EPA Grants R008223-01 and 812071-01-0.

Descriptors: *Fluvial sediments, *Phosphorus, *Bioavailability, *Bioassay, *Algae, Selenastrum, Primary productivity, Bank erosion, Suspended sediments, Model studies, Flathead Lake, Flathead River, Montana.

Primary productivity in Flathead Lake, Montana, is limited by available phosphorus; the mainstream Flathead River, the lake's major tributary, may carry as much as 200 metric tons of phosphorus associated with particulate material into the lake during the spring freshet. Major increases in primary productivity have been observed following the distribution and sedimentation of a turbidity plume that forms in the lake each spring. Understanding of the availability of phosphorus associated with the sediments was needed in order to accurately calibrate loading models for the lake. Eroding bank soils and riverine suspended sediments from the river/lake ecosystem were cultured with the alga Selenastrum capricornutum, with the sediments as the sole source of phosphorus. Extraction of phosphorus by sodium hydroxide and

nitrilotriacetic acid solutions were compared to results from algal bioassays. The fine sediment particles transported into Flathead Lake during spring runoff had the highest availability (6% of total P). Bank soils which contained the greatest percentage of fine clays exhibited similar (4% of total P) availability. Bank soils containing predominantly organic phosphorus had the lowest availability. Spearman's rank correlation indicated significance at the 5% test level between algal assay estimates of available phosphorus and both chemical extraction techniques. (Shidler-PTT)
W89-03572

IONIC CONTENT AS A FACTOR INFLUENCING TURBIDITY IN TWO FLOODPLAIN LAKES AFTER A FLOOD,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
E. G. J. Akhurst, and C. M. Breen.
Hydrobiologia HYDRB8, Vol. 160, No. 1, p 19-31, March 8, 1988. 9 fig, 5 tab, 25 ref.

Descriptors: *Lakes, *Flood plains, *Floods, *Turbidity, *Conductivity, Suspended solids, Settling velocity, Floodwater, Flushing, Transparency, Light penetration, South Africa.

The relationship between ionic content, measured as electrical conductivity, and turbidity resulting from inorganic suspensoids was investigated experimentally on the Pongolo river floodplain, South Africa. Turbid flood waters were mixed in various proportions with clear lake water of high conductivity, and settling rates determined. For the conductivity range 215-1084 microS/cm there was an increase in the maximum settling rate from 3.3-20.6%/h. These data were compared with observations made in a turbid lake of low conductivity, and a clear-water lake of high conductivity, during and after a flood. The lake in which the final conductivity was high (Lake Mhlolo--mean final conductivity 575, range 295-1230 microS/cm) cleared more rapidly than the one where the final conductivity was low (Lake Sokunti--mean final conductivity 240, range 235-244 microS/cm). The results of this study have shown that ionic content, measured as conductivity, is an important factor in the clearing of lake waters after flooding. For an individual lake the effect of ionic content on clearing can be influenced by three factors: (1) the difference between the ionic content of the lake and flood waters, (2) the efficiency of flushing while the river and lake are in contact, and (3) the final ionic content of the lake when the river and lake lose contact. (Shidler-PTT)
W89-03573

INCORPORATION OF 35SO4(2-) INTO SEDIMENTS OF THREE NEW YORK LAKES,
State Univ. of New York Coll. at Oswego. Research Center.
For primary bibliographic entry see Field 5B.
W89-03574

ACID STRESS AND LAKE BACTERIA: ULTRASTRUCTURAL AND PHYSIOLOGICAL CORRELATES OF SOME ACID AND COPPER STRESSES,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W89-03575

LAKE CHISHOLM, A POLYHUMIC FOREST LAKE IN TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
L. C. Bowling, and P. A. Tyler.
Hydrobiologia HYDRB8, Vol. 161, p 55-67, April 30, 1988. 14 fig, 2 tab, 52 ref.

Descriptors: *Limnology, *Optical properties, *Stratification, *Baseline studies, *Tasmania, Acidic water, Color, Salinity, Sulfides, Lake morphology, Euphotic zone, Thermocline, Meromictic lakes, Flagellates, Scandinavia.

Lake Chisholm is a warm, acidic, monomictic lake in western Tasmania. It is 290 m long, 238 m wide, and has a maximum depth of 13.1 m. Its large relative depth and sheltering forest result in nine months' stratification. Among its special properties is abundant allochthonous color, designated 'polyhumic'. The high humic content produces a sharp, shallow thermocline (about 2-3 m from the surface), a shallow euphotic depth (<1 m), and an underwater light climate dominated by red wavelengths. With values of electrical conductivity at 18 C of 100-130 microS/cm the lake is of moderate salinity on a Tasmanian scale, but low on a world scale. The hypolimnion is anoxic and sulfide-laden and even in winter circulation is sluggish. For much of the year the lake resembles a biogenically meromictic lake, and though there is only slight chemical enrichment of the hypolimnion there is nonetheless considerable vertical structure in the water column. Chromophyte flagellates are the dominant algae, a few species often forming monospecific blooms in a sporadic manner. Lake Chisholm is seen as an oceanic, mid-latitude counterpoint to dimictic, polyhumic, flagellate haunts in Scandinavia. (Author's abstract)
W89-03576

HORIZONTAL DIFFERENTIATION IN THE LIMNOLOGY OF A TROPICAL RIVER-LAKE (LAKE KYOGA, UGANDA),
Uganda Freshwater Fisheries Research Organization, Jinja.
S. Mungoma.
Hydrobiologia HYDRB8, Vol. 162, No. 1, p 89-96, May 9, 1988. 7 fig, 4 tab, 6 ref.

Descriptors: *Limnology, *Environmental gradient, *Tropical regions, *Species composition, *Uganda, Physicochemical properties, Nutrients, Phytoplankton, Zooplankton, Macrophytes, Influent streams, Outlets, Mixing, Lake Kyoga, Nile River.

The Nile is the largest single inflow to Lake Kyoga, but most of the lake water comes from two eastern rivers. There is a slow east-west flow mixing the two water masses towards the outflow, the Nile. The southern and western waters of the lake were characterized by low mean alkalinities (1.23 meq/l), conductivities (106 microS/cm), and pH (7.2), and high transparencies (1.7 m). In the east, comparatively high alkalinities (1.96 meq/l), conductivities (168 microS/cm), and pH (7.4), and low transparencies (0.8 m) were encountered. Hardness varied from 0.6 meq/l in the west to 1.0 meq/l in the east. Silica and sulfate decreased westward from the eastern lake arms, while nitrate and phosphate varied seasonally in the lake, which was mostly saturated with oxygen (86-120%) from the surface to the bottom. Some evidence of polymixis was encountered. A rich phytoplankton flora occurred with the major groups well represented by Chlorophyceae (37%), Bacillariophyceae (36%), and Cyanophyceae (26%). Synedra spp. (20%), Anabaena spp. (16%) and Nitzschia spp. (10%) were the dominant species groups during July/August 1981. The macrophyte genera Vallisneria, Potamogeton, Nymphaea, Ceratophyllum, and Hydrilla occurred prominently in the clearer southern lake water. Rotifers and crustacean zooplankters found were also recorded. Meroplanktonic crustaceans and chironomids and other insects often occurred in large numbers. (Author's abstract)
W89-03577

HETEROTROPHIC BACTERIAL ACTIVITY AND PRIMARY PRODUCTION IN A HYPERTROPHIC AFRICAN LAKE,
National Inst. for Water Research, Pretoria (South Africa).
R. D. Robarts.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 97-107, May 16, 1988. 6 fig, 4 tab, 44 ref.

Descriptors: *Limnology, *Reservoirs, *Heterotrophic bacteria, *Primary productivity, *Africa, Phytoplankton, Cyanophyta, Organic carbon, Epilimnion, Euphotic zone, Biomass, Chlorophyll a, Glucose, Absorption, Statistical analysis.

The relationship between heterotrophic bacteria and phytoplankton in the epilimnion of Hartbeespoort Dam, South Africa, was examined by statistically analyzing three years of parallel measurements of glucose uptake and phytoplankton particulate and dissolved-organic-carbon (DOC) production. Algal biomass ranged between 4.0 and 921.1 mg chlorophyll a/cubic m at the surface. Primary production varied between 69.5 and 3010.0 mg C/square m/h while algal production of DOC ranged from 2.5 to 219.2 mg C/square m/h. Bacterial numbers reached a summer peak of 44,230,000 cells/ml in the first year and showed no depth variation. The maximum rate of glucose uptake reached a peak of 5.52 microg C/l/h. Maximum glucose uptake rate, maximum glucose concentration, and glucose turnover time were usually highest at the surface and decreased with depth concomitant with algal production. At the surface, maximum rate of glucose uptake was correlated with DOC and primary production. At 5 and 10 m, maximum glucose uptake rate was correlated with integral euphotic zone algal production and bacterial numbers. Glucose-turnover time was inversely related to integral algal production and less strongly to bacterial numbers. The data indicated that although bacterial numbers and biomass were low relative to algal biomass in this hypertrophic lake, heterotrophic bacteria attained high rates of metabolic activity as a result of enhanced algal production of available organic carbon. (Author's abstract)
W89-03578

TEMPORAL DYNAMICS AND SPATIAL VARIATION OF ALGAE IN RELATION TO HYDROLOGY AND SEDIMENT CHARACTERISTICS IN THE OKEFENOKEE SWAMP, GEORGIA,
Georgia Univ., Athens. Inst. of Ecology.
S. A. Schoenberg, and J. D. Oliver.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 123-133, May 16, 1988. 7 fig, 3 tab, 51 ref. NSF grant BSR 82 15587.

Descriptors: *Limnology, *Okefenokee Swamp, *Swamps, *Algae, *Georgia, Chlorophyll a, Cycling nutrients, Epiphytes, Phosphorus, Phytoplankton, Hydrology, Sediments.

In a 20-month study, phytoplankton and periphyton chlorophyll a and dry mass of macroscopic algal aggregates in four marshes and a lake within the Swamp were comparable to other wetlands and lake littoral areas. Chlorophyll levels in two marshes were inversely related to water level, and phytoplankton at three marshes developed unimodal maxima following macrophyte dieback. Standing stocks in a vernally-inundated marsh were greater than in a nearby marsh which was permanently inundated; chlorophyll levels displayed longer blooms in the inundated marsh during periods of low rainfall or after drought. Field dynamics, sediment sorption characteristics, and algal bioassays suggest that evaporative drawdown stimulates algae by release of nutrients from exposed peat, while high water levels reduce nutrient release from sediments and disperse phytoplankton through flushing. Equilibrium phosphate concentrations of sediments and algal levels were higher at an abandoned rookery than a nearby non-rookery area, indicating nutrient enrichment from residual guano deposits. (Author's abstract)
W89-03580

BIOLOGICAL EFFECTS OF NITRATE FERTILIZATION AND WATER REPLACEMENT IN AN OLIGOTROPHIC COLD WATER POND,
Oregon Univ., Eugene. Dept. of Biology.
W. K. Dodds, and R. W. Castenholz.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 141-146, May 16, 1988. 2 tab, 21 ref.

Descriptors: *Limnology, *Cold springs, *Oligotrophic lakes, *Nitrates, *Fertilization, Flushing, Limiting nutrients, Nostoc, Mesocosms, Phosphorus, Nitrogen fixation, Chlorophyll, Sediments, Diatoms, Plant growth, Cyanophyta.

Plastic enclosures (limnocorrals) were used to assess the impact of adding nitrate to an oligotrophic pond. The pond, Mare's Egg Spring, is spring

fed at a constant temperature of 4.5 C (the main portion of the pool never exceeded 6 C) and a molar ratio of N:P of 0.5. The pool is dominated by the cyanobacterium (blue green alga), Nostoc pruniforme, which is capable of nitrogen fixation. This, in combination with the low N:P ratio, suggested that non-nitrogen fixing primary producers were limited by nitrogen. Over a period of one month, growth and nitrogen fixation of Nostoc, suspended chlorophyll, sediment denitrification, and benthic diatom diversity were not dependent upon nitrogen concentration. However, sedimentary chlorophyll levels increased slightly when nitrate levels were increased from 0.71 microM (ambient) to 214 microM. Limnocorrals with slit sides gave water-replacement rates between those for complete enclosure and those in open water. In the open channel, Nostoc growth was highest, and suspended chlorophyll the lowest. In the closed corrals, Nostoc growth was the lowest and suspended chlorophyll the highest, with intermediate values in the slit corrals. Therefore, short-term increases of nitrate levels in nitrogen-poor aquatic systems do not necessarily affect the biological community, but slowing water replacement in small ponds may have significant effects. (Author's abstract)
W89-03581

ZOOPLANKTON ABUNDANCE AND TRANSPORT IN A TROPICAL WHITE-WATER RIVER,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
J. F. Saunders, and W. M. Lewis.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 147-155, May 16, 1988. 5 fig, 2 tab, 24 ref. NSF grants DEB 8116725 and BSR 8315410.

Descriptors: *Population dynamics, *Rivers, *Stream biota, *Zooplankton, *Rotifers, *Tropical regions, Animal populations, Aquatic drift, Crustaceans, Copepods, Waterfleas, Flow discharge, Flooding, Braided streams, Flushing, Flood plains, Secondary productivity, Venezuela.

Much of the lower portion of the drainage basin of the Apure River in western Venezuela is subject to seasonal flooding. Although more than 50 zooplankton species were recorded during this study, nine rotifer species accounted for more than 90% of total density. Copepods were represented primarily by Mesocyclops decipiens. Cladocerans were not abundant, and most were planktonic. Crustaceans comprised 46% of annual mean zooplankton biomass but only 2% of zooplankton numbers. Zooplankton abundance showed a strong, inverse relationship to discharge. Secondary branches of the braided channel appeared to be the primary source areas, but populations of some species also reproduced in the main channel at low water. As the river began to rise, the secondary branches were flushed and thus abruptly ceased to serve as source areas. Zooplankton transport fell sharply and remained low until the river inundated the floodplain. Secondary production in the floodplain was exported to the river as long as a connection existed. After drainage ceased from the floodplain, transport fell to very low levels until the secondary branches again became suitable habitat. Seasonal fluctuations in river level regulated the development of source areas suitable for zooplankton growth and controlled the export of plankton from the source areas. Plankton in the running waters reproduced only at low water. (Author's abstract)
W89-03582

SECCHI DISK-CHLOROPHYLL RELATIONSHIPS IN A LAKE WITH HIGHLY VARIABLE PHYTOPLANKTON BIOMASS,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. M. Tilzer.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 163-171, May 16, 1988. 3 fig, 1 tab, 27 ref.

Descriptors: *Limnology, *Transparency, *Secchi disks, *Phytoplankton, *Chlorophyll, Optical properties, Euphotic zone, Light penetration, Light quality, Turbidity, Particulate matter, Biomass, Eutrophication, Lake Constance.

In meseutrophic Lake Constance mean euphotic phytoplankton chlorophyll concentrations vary about 100-fold over the year. Concomitant fluctuations in euphotic depth and Secchi depth are related to each other in a nonlinear fashion. Secchi depth is to a great extent a function of beam attenuation of light which depends on the inherent optical properties of water and is highly sensitive to light scattering from particles. Euphotic depth, by contrast, is a function of the vertical light attenuation coefficient which also depends on absorption and scattering, but is less sensitive to the latter than beam attenuation. Algal cells both absorb and scatter light and therefore influence Secchi depth and euphotic depth, however, in different fashions. Whenever the lake is clear due to scarce phytoplankton, scattering is small and beam attenuation exceeds vertical light attenuation by only a relatively small factor. As a consequence, the ratio of euphotic depth to Secchi depth is small (1.5-2.5). When the lake is turbid due to high algal density, enhanced scattering from algal cells and detrital particles causes beam attenuation to rise more than vertical light attenuation, thus leading to high ratios of euphotic depth to Secchi depth (3-5). The relatively close relationships between Secchi depth and chlorophyll in Lake Constance are due to (1) high influence of chlorophyll concentration on water transparency, (2) covariation of phytoplankton and other suspended particles, and (3) limited variation of cellular chlorophyll counts. (Author's abstract)
W89-03583

NICHE CONGRUENCY OF AQUATIC MACROPHYTES IN CENTRAL NORTH AMERICA WITH RESPECT TO 5 WATER CHEMISTRY PARAMETERS,
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 173-182, May 16, 1988. 3 fig, 1 tab, 27 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Ecology, *Niches, Alkalinity, Chlorides, Sulfates, Phosphorus, Dissolved solids, Cluster analysis, Principal component analysis, Ecological distribution.

The occurrences of macrophytes were studied at 430 sites with respect to total alkalinity, chloride, sulfate, molybdenum-reactive phosphorus, and dissolved organic matter. Mean niche positions were calculated for the combination of 5 parameters by comparing mean values for each species using agglomerative hierarchical cluster analysis. Overall niche relations were examined by calculating and summing the amount of overlap in the observed ecological tolerance ranges for the 5 parameters for each species pair, and applying cluster and principal component analysis. The results showed that the macrophytes occupied a broad spectrum of niches, ranging from species found at low inorganic concentrations and narrow tolerance ranges, to species occupying broad ranges in the study area. Species with similar overall niches differed with respect to their mean niche positions, and vice versa. Macrophytes with similar niche positions may use a number of strategies to reduce interspecific competition. They may show different growth forms or occupy slightly different regions of a given habitat in terms of depth ranges, substrate preferences, or exposure. Others may have reduced competition by showing differences with respect to other variables, such as water-body type or turbulence. (Author's abstract)
W89-03584

PHYSICO-CHEMICAL LIMNOLOGY OF ELEVEN, MOSTLY SALINE PERMANENT LAKES IN WESTERN VICTORIA, AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Zoology.
P. De Deckker, and W. D. Williams.
Hydrobiologia HYDRB8, Vol. 162, No. 3, p 275-286, May 24, 1988. 6 fig, 9 tab, 21 ref.

Descriptors: *Limnology, *Saline lakes, *Physicochemical properties, *Australia, Salinity, Ions, Hydrogen ion concentration, Nitrogen, Turbidity.

The purpose of this study was to document some of the major parameters of a series of large (1.1 to 251 square km in area), mostly shallow (averaging less than 6 m in depth), and fresh to only moderately saline lakes situated on volcanic terrain. Mean salinities were 0.3 to 56.6 g/l, and seasonal differences were slight. Major cations were ranked sodium > magnesium > calcium > or < potassium; anion rank was chloride > bicarbonate > carbonate > sulfate. Generally pH was 8.0 to 9.0. Noteworthy physico-chemical features of the lakes were: (1) the remarkable similarity of the ranking of major ions in all the saline lakes, (2) dampened salinity fluctuations and lack of marked seasonal salinity change, (3) little pH variation (thus, well-buffered waters), (4) indications that nitrogen and not phosphorus appeared often to be limiting as a plant nutrient, and (5) frequently high (but always variable) turbidity values in the shallow lakes (Secchi-disk transparencies sometimes < 5 cm). (Shidler-PTT)
W89-03585

INTEGRATED APPROACH TO HYDROPOWER IMPACT ASSESSMENT. I. ENVIRONMENTAL FEATURES OF SOME NORWEGIAN HYDRO-ELECTRIC LAKES,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 6G.
W89-03586

IMPACT OF DISSOLVED AMINO ACIDS ON PROTEIN AND CELLULOSE DEGRADATION IN STREAM WATERS,
Lund Univ. (Sweden). Lab. of Ecological Chemistry.
G. Bengtsson.
Hydrobiologia HYDRB8, Vol. 164, No. 2, p 97-102, July 20, 1988. 3 tab, 2 fig, 14 ref.

Descriptors: *Streams, *Amino acids, *Proteins, *Degradation, *Cellulose, *Nutrients, Albumin, Bacteria, Carbon, Nitrogen compounds, Nutrients, Radiochemical analysis, Wastewater.

Dissolved amino acids represent a significant carbon and nitrogen source for microorganisms in stream-water environments, and may be utilized in preference to protein-bound nitrogen in decomposing organic matter. Consequently, in streams with sufficiently high concentrations of dissolved amino acids, depolymerization of nitrogen compounds may become delayed. This possibility was investigated in stream-water samples incubated with C-14-labeled albumin and cellulose in the presence of the indigenous microorganisms at different concentrations of dissolved amino acids. The experiments demonstrated on the average between 15 and 25% lower degradation of the compounds during a ten days' incubation at an initial amino-acid concentration of 1 mg/l. The reduction was most clearly expressed in a nutrient-poor stream-water compared with a nutrient-rich. The kinetics of the degradation were most appropriately described by a first-order model, that is, the rate of transformation of the macromolecules was independent of the total number of bacteria in the water. The mechanism suggested for the retardation of macromolecules is a superproportional utilization of the dissolved amino acids at high concentrations, a phenomenon that can cause accumulation of slowly-decomposing macromolecules in sediments affected by residual wastewater. (Author's abstract)
W89-03587

PLANKTON COMMUNITY CYCLING AND RECOVERY AFTER DROUGHT: DYNAMICS IN A BASIN ON A FLOOD PLAIN,
Commonwealth Scientific and Industrial Research Organization, Lyneham (Australia). Div. of Wildlife and Rangelands Research.
F. H. J. Crome, and S. M. Carpenter.
Hydrobiologia HYDRB8, Vol. 164, No. 3, p 193-211, July 29, 1988. 6 fig, 1 tab, 40 ref, append.

Descriptors: *Limnology, *Swamps, *Zooplankton, *Population dynamics, *Drought, *Flood plains, River systems, Intermittent lakes, Drawdown, Water level fluctuations, Turbidity, Sus-

pended solids, Species diversity, Population density, Succession, Rotifers, Crustaceans.

Lake Merrimajeel, a shallow swamp, is part of the Murray-Darling, a flood-plain river system with high plankton diversity. It fluctuates drastically in water level and often dries out. The dynamics and seasonality of zooplankton in the face of these fluctuations and the effect of a total drawdown and refilling were monitored between February 1977 and January 1980. During this period thirty species of rotifers, thirty-four of microcrustacea, and several other species were recorded. Despite erratic fluctuations in water level, temperature, and turbidity a community cycle from dominance by rotifers in summer/autumn to crustacea in winter/spring was maintained. Diversity and density reached a maximum just before the drawdown, during hot, turbid, conditions. During this drying phase the waters remained relatively fresh and well oxygenated. The recovery phase was characterized by a group of rare species. It is postulated that these rare, colonizing or successional species are dependent on a brief flush of rich organic material produced on flooding. The generally depressive effect of increased turbidity does not hold in this lake and many limnetic species were abundant during periods of high turbidity. It is suggested that turbidity may be tolerated or even be advantageous to some species, depending on the nature of the suspended material. (Author's abstract)
W89-03588

SEDIMENT CHEMISTRY OF LAKES FORMED BY SURFACE-MINING FOR COAL IN THE MIDWESTERN U.S.A.,

Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
R. B. Brugam, S. Chakraverty, and J. Lamkin.
Hydrobiologia HYDRB8, Vol. 164, No. 3, p 221-233, July 29, 1988. 8 fig, 4 tab, 25 ref. Department of Interior project B-138-ILL.

Descriptors: *Limnology, *Strip mine lakes, *Lake sediments, *Neutralization, *Acid mine drainage, Sulfides, Heavy metals, Mine wastes, Acid mine drainage, Leaching, Water quality, Hydrogen ion concentration.

Sediment from lakes on abandoned coal mines was examined to determine the factors controlling chemical composition and the role the sediment plays in lake neutralization. Sediment concentrations of many cations (especially heavy metals) are strongly correlated with sediment-sulfide concentration, but poorly correlated with the pH of the overlying water. Leaching the sediment of one lake with 1 N ammonium acetate and 0.1 and 6 N hydrochloric acid revealed that cations were mostly bound in weak acid-leachable and strong acid leachable forms. The weak form is likely to be metal sulfides and calcium carbonate. The sulfide-poor sediments of extremely acid lakes contained few weak acid-leachable cations. Raw mine-spoil contained large amounts of easily-leached cations. There is little relationship between changes in sediment chemistry over time determined from cores of lake sediment and past lake pH. Rates of sulfide deposition were examined in sediment cores because sulfate reduction and deposition has been suggested as a major source of alkalinity in lakes influenced by acid precipitation. Although the rate of sulfate deposition in surface mine lakes is high, it alone seems to be insufficient to cause neutralization. (Author's abstract)
W89-03589

PELAGIC FOOD WEB PROCESSES IN AN OLIGOTROPHIC LAKE,

Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard, B. Riemann, L. M. Jensen, N. O. G. Jorgensen, and P. K. Bjornsen.
Hydrobiologia HYDRB8, Vol. 164, No. 3, p 271-286, July 29, 1988. 12 fig, 5 tab, 54 ref.

Descriptors: *Limnology, *Oligotrophic lakes, *Food chains, *Carbon cycle, *Primary productivity, Eutrophication, Nutrients, Photosynthesis, Amino acids, Bacteria, Chrysophyta, Phytoplankton, Zooplankton, Denmark.

Major pelagic carbon pathways, including primary production, release of extracellular products (EOC), bacterial production, and zooplankton grazing were measured in oligotrophic Lake Almind (Denmark) and in enclosures (7 cubic m) subjected to artificial eutrophication. The flow of organic carbon was dominated by phytoplankton EOC release, which amounted to from 44 to 58% of the net fixation of inorganic carbon. Gross bacterial production accounted for 33 to 75% of the primary production. The lower values of EOC release (44%) and bacterial production (33%) were found in the enclosures with added nutrients. The release of recently-fixed photosynthetic products was the most important source of organic carbon to the bacterioplankton. Uptake of dissolved free amino acids was responsible for 52 to 62% of the gross bacterial production. Thus, amino acids constituted a significant proportion of the EOC. Zooplankton (<50 microns) grazing on algae and bacteria accounted only for a minor proportion of the particulate production. Circumstantial evidence suggests that the chrysophycean alga Dinobryon was the most important bacterial remover. The results clearly demonstrated EOC release and bacterial metabolism to be key processes in pelagic carbon cycling in this oligotrophic lake. (Author's abstract)
W89-03590

LAKE KINNERET PHYTOPLANKTON: RESPONSE TO N AND P ENRICHMENTS IN EXPERIMENTS AND IN NATURE,

Kinneret Limnological Lab., Tiberias (Israel).
U. Pollingher, T. Berman, B. Kaplan, and D. Scharf.
Hydrobiologia HYDRB8, Vol. 166, No. 1, p 65-75, September 9, 1988. 4 fig, 3 tab, 32 ref. Israel National Council for Research and Development grant WT-12.

Descriptors: *Eutrophication, *Lakes, *Phytoplankton, *Nitrogen, *Phosphorus, *Enrichment, Limiting nutrients, Chlorophyll, Chlorophyta, Flagellates, Cyanophyta, Diatoms, Algal growth, Lake Kinneret, Limnology.

A series of water samples from Lake Kinneret was supplemented with 100 microM nitrogen (as ammonium or as nitrate) and/or 10 microM orthophosphate phosphorus. The yield of phytoplankton both as chlorophyll and in cell numbers of major species was determined after a two-week incubation. During these experiments, some of the algae present initially never multiplied (e.g., Peridinium and Peridinopsis spp., Cryptomonas spp., Rhodomonas spp., and Crysochromulina parva); others (e.g., Anomoeoneis exilis, Synedra sp., Chlamydomonas sp., Elakatothrix gelatinosa), undetected in the original sample, grew out during the incubation. Chlorophyte species (the majority of commonly-observed forms in the lake) responded most readily to added nutrients. The results of these enrichment experiments were related to the long-term record of phytoplankton populations observed in the lake and suggest that through summer and fall, when ambient levels of both P and N are minimal, P was generally, but not always, the most limiting nutrient for algal growth. In the spring, after the decline of the Peridinium bloom, P appeared to be limiting the growth of Chlorophyta. Although most algal species grew equally well on ammonium or nitrate, some species appeared to respond preferentially either to the ammonium (Coelastrum, Chodatella) or to the nitrate (Chroococcus, Anomoeoneis) source of N. (Author's abstract)
W89-03591

DISSOLVED ORGANIC CARBON FLUCTUATIONS IN DAL LAKE WATERS,

Kashmir Univ., Srinagar (India). Dept. of Botany.
K. Koul, and V. Kaul.
Hydrobiologia HYDRB8, Vol. 166, No. 3, p 199-203, September 30, 1988. 4 fig, 1 tab, 17 ref.

Descriptors: *Limnology, *Lakes, *Organic carbon, *Water temperature, *Hydrogen ion concentration, Dissolved solids, Correlation analysis, Ecosystems, Alkaline water, Phytoplankton, Primary productivity, Secondary productivity.

Determining the fate of dissolved organic carbon (DOC) is important for an understanding of the energy flow in aquatic ecosystems. This paper documents a study of the fluctuations in DOC concentrations, along with temperature and pH, in the surface water of Lake Dal from May 1984 to April 1985. Concentration of DOC varied from 0.140 mg/l to 0.725 mg/l. A minimum was recorded in May and September, while an increase was observed during December and January. The pH (7.6-8.5) fell in the alkaline range throughout the year. Water temperature varied from 5 C to 27 C with the lowest prevailing during the months of December and January. The DOC fluctuations during the observation period showed a relationship with temperature and pH. The DOC concentration seems to be closely related to the growth of phytoplankton and other primary and secondary producers which in turn are affected by water chemistry, water temperature and other factors characterizing such habitats. Thus the relationship between temperature and pH with DOC is likely indirect. (Shidler-PTT)
W89-03592

USE OF PERIPHYTON COMMUNITIES FOR NUTRIENT REMOVAL FROM POLLUTED STREAMS,

Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5G.
W89-03594

USE OF BIOMONITORING IN MICHIGAN'S SURFACE WATER QUALITY PROGRAM,

Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
P. D. Zugger.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 703-784. 1 fig, 9 tab, 2 ref, 4 append.

Descriptors: *Bioassay, *Surface water, *Water quality, *Michigan, *Bioassay, Fish, Toxicity, Great lakes, Pollutants.

Biomonitoring is the assessment of water quality through the observation of impacts of contaminants in water and wastewater on biological organisms. Michigan's biomonitoring program consists of both a surveillance and a compliance monitoring aspect. Surveillance monitoring is comprised of fish contamination monitoring and biological lake and stream assessments. The goal of the fish contaminant monitoring program is to collect and analyze data on contaminant levels in fish so that fisheries managers, water quality administrators, public health officials, and the public can make informed decisions and be apprised of the contaminant levels in fish from various geographical areas of Michigan. Biological lake and stream assessments, or biosurveys, are the traditional means of assessing the quality of ambient water. Michigan conducts approximately 30 site investigations and 10 intensive studies per year. Compliance biomonitoring assures that discharges do not cause unacceptable toxicity. The following situations receive priority attention for compliance monitoring activities: wastewater discharges with permits scheduled for reissuance in two years; industrial/municipal facilities which discharge wastewater to watersheds targeted for special attention; wastewater discharges which have whole effluent toxicity limits and/or toxicity testing requirements in their permits; and industrial/municipal effluents or leachates, known or suspected of being toxic to aquatic life. The following tests are conducted with standard reference toxicants: Daphnia static acute toxicity test (monthly); Ceriodaphnia static acute toxicity test (monthly), Larval fathead minnow static acute toxicity test (monthly); Ceriodaphnia survival and reproduction test (quarterly); and Fathead minnow larval survival and growth test (quarterly). (See also W89-03657) (Davis-PTT)
W89-03677

ROBUST BAYES MODELS OF FISH RESPONSE TO LAKE ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-03686

REGIONAL APPLICATION OF A SIMPLE LAKE ACIDIFICATION MODEL TO NORTHERN EUROPE,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 6A.
W89-03687

DEVELOPMENT OF A LAKE ACIDIFICATION MODEL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03696

SENSITIVITY OF N2-FIXING BLUE-GREEN ALGAE IN COMPETITION FOR GROWTH PREREQUISITES,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Hydrology and Water Resources Engineering.
For primary bibliographic entry see Field 5C.
W89-03713

LAKE TRAVERSE ROPE (RESERVOIR OPERATION PLAN EVALUATION): PROBLEM APPRAISAL REPORT.
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 6G.
W89-03745

CLADOPHORA GLOMERATA AND ITS DIATOM EPIPHYTES IN THE COLORADO RIVER THROUGH GLEN AND GRAND CANYONS: DISTRIBUTION AND DESSICATION TOLERANCE,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W89-03776

CARBON FLOW FROM LIGNOCELLULOSE: A SIMULATION ANALYSIS OF A DETRITUS-BASED ECOSYSTEM,
Georgia Univ., Athens. Inst. of Ecology.
M. A. Moran, T. Legovic, R. Benner, and R. E. Hodson.
Ecology ECOLAR, Vol. 65, No. 5, p 1525-1536, October 1988. 6 fig, 5 tab, 56 ref.

Descriptors: *Wetlands, *Carbon cycle, *Cellulose, *Lignin, *Ecosystems, *Simulation analysis, *Detritus, Swamps, Food chains, Decomposition, Georgia, Marshes, Microbial degradation.

A simulation model is used to predict the fate of carbon derived form lignocellulose in the food web of a marsh community in the Okefenokee Swamp, Georgia. The model, constructed from empirical work spanning a 6-yr period, predicts the role of lignocellulose-derived detritus in supporting secondary production in this ecosystem. Although Carex walteriana lignocellulose is the dominant product of primary production in this marsh and the dominant source of detritus, the model predicts that it may not be quantitatively important in the support of trophic groups other than bacteria and protozoa. The efficiency of transfer of lignocellulosic carbon through the microbial loop is low, and overall only 8% of the carbon used by bacteria and fungi is predicted to be ingested subsequently by metazoans. An average of 32% of the bacterial biomass in the marsh water and sediments is predicted by the model to be produced at the expense of lignocellulosic carbon, whereas $<10\%$ of the biomass of larger detritovorous animals can be traced to carbon from lignocellulose. Thus in this marsh ecosystem, detritus food webs based on other, less abundant, sources of detrital carbon, or perhaps classical plant-herbivore food webs, are more likely to be the major source of carbon for metazoan production. (Author's abstract)
W89-03819

NUTRIENT INFLUENCE ON A STREAM GRAZER: ORTHOCLADIUS MICROCOMMUNITIES RESPOND TO NUTRIENT INPUT,
Minnesota Univ.-Duluth. Dept. of Biology.
A. E. Hershey, A. L. Hiltner, M. A. J. Hullar, M. C. Miller, and J. R. Vestal.
Ecology ECOLAR, Vol. 65, No. 5, p 1383-1392, October 1988. 5 fig, 2 tab, 28 ref.

Descriptors: *Stream biota, *Midges, *Enrichment, *Microenvironment, *Nutrients, Algae, Enrichment, Alaska, Larval growth stage, Food habits.

A whole-stream enrichment experiment of phosphorus and, further downstream, of phosphorus and nitrogen, allowed the examination of the growth and density responses of the tube-building larval chironomid Orthocladius rivulorum to nutrient enrichment of the Kuparuk River in arctic Alaska, and to evaluate nutrient effects on the tube microbial community. The larva feeds by grazing a diatom monoculture of Hannaea arcus from the tube exterior, thus direct nutrient effects on the tube microbiota may translate in indirect nutrient effects on the larva. Electron microscopy indicated that tube silk was formed into a sheet, with a filamentous substructure that repeated at 50-nm intervals. Bacterial microcolonies occurred at the points where the erect diatoms were attached to the silk. Microbial activity of Orthocladius tubes in the P-fertilized section was 2-3 times that of the control section of the river, and total microbial biomass in the P-fertilized section was 3-4 times that of the control section. Chlorophyll a was also higher on Orthocladius tubes downstream of both P and N + P fertilization sites. However, the rate of biomass accumulation on tubes was more rapid downstream of N + P addition, suggesting primary P and secondary N limitation of the rate of primary production in the river. Chlorophyll a was higher on tubes than on rocks or experimental tiles, which indicated that tubes were a more favorable algal habitat for Hannaea. Pupal tubes had less chlorophyll a than larval tubes, suggesting that larval activity may have contributed to the higher algal biomass on tubes. Orthocladius benefited from the enhanced tube flora; larvae grew larger in the fertilized sections of the stream than in the upstream sections. Orthocladius with its tube and associated biota function as microcommunities that respond directly and indirectly to the surrounding nutrient regime, but have considerable trophic independence from surrounding portions of the epilithon. They may constitute 12-43% of total epilithic algal biomass. (Author's abstract)
W89-03820

INVESTIGATIONS OF THE LAKE ECOSYSTEM MODEL EMSY BY MEANS OF THE SIMULATION SYSTEM SONCHES,
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H.-P. Kozerski, H. Behrendt, G. Schellenberger, and V. Mohaupt.
Ecological Modelling ECMOOT, Vol. 41, No. 3/4, p 193-200, June 1988. 7 fig, 11 ref.

Descriptors: *Eutrophic lakes, *Mathematical Models, *Simulation analysis, *Ecosystems, Nitrogen, Phosphorus, Phytopolankton, Zooplankton.

A simplified model (EMSY) for shallow eutrophic lakes including phytoplankton, detritus, zooplankton, dissolved inorganic N and P and organic matter in the sediment has been developed and tested on data for 3 lakes. Comparisons of model results with the measurements of 10 years, as well as with simulation results of a more extended model, were made. They demonstrated the suitability of this simplified model. A further step in modeling will be the coupling of the model EMSY with river model ERNA to a model of the whole river system. The simulation system SONCHES has been proved as a tool to facilitate the programming and handling of the model. (Author's abstract)
W89-03822

SIMPLIFIED SENSITIVITY ANALYSIS APPLIED TO A NUTRIENT-BIOMASS MODEL,
Saint Martin's Coll., Lacey, WA. Dept. of Civil Engineering.
D. S. Mahamah.
Ecological Modelling ECMOOT, Vol. 42, No. 2, p 103-109, August 1988. 6 fig, 7 ref.

Descriptors: *Mathematical models, *Sensitivity analysis, *Ecology, Nutrient-biomass model.

Sensitivity analysis is a technique used in the identification of model aspects most susceptible to uncertainties in model development. The parameter variation method is one of such techniques for analyzing models for sensitivity. The paper examines the application of a simplified parameter variation analysis to a nutrient-biomass model. In particular, model coefficients are examined with graphs of normalized sensitivity coefficients developed as a function of time of simulation. From the analysis it is concluded that model variables are most sensitive to variations in algal loss rate and phosphorus yield coefficient. Furthermore, it is confirmed that the system is phosphorus-limited. (Author's abstract)
W89-03824

DYNAMICS OF A STABLE, LARGE VOLUME, LABORATORY ECOSYSTEM CONTAINING DAPHNIA AND PHYTOPLANKTON,
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
U. Borgmann, E. S. Millard, and C. C. Charlton.
Journal of Plankton Research JPLRD9, Vol. 10, No. 4, p 691 - 713, July 1988. 6 fig, 3 tab, 29 ref.

Descriptors: *Limnology, *Daphnia, *Mathematical models, *Phytoplankton, *Ecosystems, *Population dynamics, Aquatic populations, Algae, Algae harvesting, Biomass, Nutrients, Chlorophyll, Phosphorus, Sedimentation, Zooplankton, Lake Michigan.

Daphnia magna and phytoplankton were maintained in stable, large-volume (3400 l), indoor, planktonic model ecosystems for up to 20 weeks. Ecosystem stability was demonstrated by damped oscillations in population abundance, and by a return to steady-state conditions if the system was perturbed. The steady-state biomass of daphnia and algae responded to variations in nutrient loading rates and daphnia harvesting rates in accordance with predictions from a mathematical model. Increased nutrient addition resulted in an increase in biomass of daphnia, but not phytoplankton, if both were present. Increased harvesting caused an increase in chlorophyll and decreased daphnia biomass. Phosphorus additions were balanced by sedimentation losses which were proportional to daphnia biomass. Increased harvesting rates resulted in decreased phosphorus loss rates and increased efficiency of phosphorus conversion into harvested daphnia. Damped oscillations had a periodicity of 3.5 weeks and could be successfully modeled assuming a half-saturation constant for phosphorus control of algal growth of 1 microgram/l. The ecosystem became unstable if nutrient loading rates exceeded a defined limit which was a function of harvesting rates. Steady-state chlorophyll and daphnia biomass levels were similar to levels approached in Lake Michigan in summer in 1983 and 1984, when the zooplankton biomass was dominated by Daphnia pulicaria. (Author's abstract)
W89-03840

EFFECTS OF LOW CONCENTRATIONS OF HEAVY METALS ON PLANKTON COMMUNITY DYNAMICS IN A SMALL, SHALLOW, FERTILE LAKE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W89-03841

PHYSICAL AND CHEMICAL STUDIES ON THE SEDIMENTS OF THE ST-POINT LAKE (JURA MOUNTAINS): CARTOGRAPHY (ETUDE PHYSICO-CHIMIQUE DES SEDIMENTS DU LAC DE ST-POINT (MASSIF DU JURA): CARTOGRAPHIE THEMATIQUE),
Universite de Franche-Comte, Besancon (France). Lab. d'Hydrobiologie - Hydroecologie.
For primary bibliographic entry see Field 2J.
W89-03843

RELATIONSHIPS BETWEEN PHYTOPLANKTON PHOTOSYNTHESIS AND LIGHT IN A MESOTROPHIC RESERVOIR (PARELOUP): SEASONAL VARIATIONS OF PARAMETERS (RELATIONS ENTRE LA LUMIERE ET LA PHOTOSYNTHESE DU PHYTOPLANCTON DANS UN RESERVOIR MESOTROPHE (PARELOUP): VARIATIONS SAISONNIERES DES PARAMETRES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
J. Capblancq, J. M. Thebault, and A. Jrad.
Annales de Limnologie ANLIB3, Vol. 24, No. 1, p 39-48, 1988. 7 fig, 3 tab, 17 ref. English summary.

Descriptors: *Limnology, *Phytoplankton, *Photosynthesis, *Solar radiation, *Primary productivity, Light intensity, Lakes, Mesotrophic lakes, Reservoirs, Seasonal variation, France.

The relationships of vertical profiles of phytoplankton photosynthesis to underwater light were analyzed in a series of 48 experiments performed in the mesotrophic reservoir of Pareloup. The light saturated photosynthetic rates (P sub opt), the initial slope of light saturation curves (alpha) and the quantum yield at limiting light intensities (phi sub m) vary over more than one order of magnitude. A strong correlation appears between alpha and P sub opt which suggests the possibility of predicting the values of one from those of the other. Both parameters are correlated with chlorophyll concentration and temperature but these two factors account for only 43% of the variance of P sub opt. Changes in the photosynthetic light responses by phytoplankton were observed during summer when the euphotic layer became thermally stratified. These results are discussed with regard to predictive models of phytoplankton production. (Author's abstract)
W89-03845

MACROBENTHOS OF THE SAONE RIVER (LE MACROBENTHOS DE LA SAONE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
T. Tachet, O. Gaschignard-Fossati, B. Cellot, and A. Berly.
Annales de Limnologie ANLIB3, Vol. 24, No. 1, p 83-100, 1988. 12 fig, 2 tab, 35 ref. English summary.

Descriptors: *Aquatic insects, *Benthos, *Saone river, *France, *Stream biota, *Rivers, *Benthic fauna, Mayflies, Zoning, Bottom sampling.

The macrobenthos of the Saone River (France) were sampled with a dredge at 13 stations distributed along 377 km. The macrobenthos of this large river is dominated, in the least altered stations, by the burrowing mayflies (Ephoron virgo and Ephemera lineata). The comparison of these benthic communities with those of the Upper Rhone River, a water course with similar discharges and dimensions, shows that the Saone is, typologically, more downstream than the Upper Rhone. The importance and the duration of low waters combined with the differences of slope are probably the most significant factors defining the composition of benthic communities of these two rivers. (Author's abstract)
W89-03846

RESPONSE OF YOUNG-OF-THE-YEAR CUTTHROAT TROUT TO MANIPULATION OF HABITAT STRUCTURE IN A SMALL STREAM,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
K. M. S. Moore, and S. V. Gregory.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 2, p 162-170, March 1988. 5 fig, 3 tab, 23 ref. NSF Grant BSR-8112455.

Descriptors: *Channel morphology, *Aquatic habitats, *Fish, *Trout, *Streams, *Fish populations, Eddies, Backwater, Population density, Streamflow.

In Mack Creek, a third-order stream flowing through a 450-year-old coniferous forest in Oregon's Cascade Mountains, population size of young-of-the-year cutthroat trout Salmo clarki was positively correlated with length of stream edge and area of lateral habitat. Lateral habitats included backwaters and eddies at the margin of the channel that made up 10-15% of total stream area. Lateral habitat area was reduced at higher or lower streamflow, but the length of channel perimeter formed by lateral habitats was never less than twice the length of the reach. In an experimental manipulation of lateral habitat before the emergence of young fish from the redd, an increase in lateral habitat area of 2.4 times the area observed in control reaches resulted in a 2.2-times greater density of age-0 cutthroat trout. Young-of-the-year fish were virtually eliminated from stream sections with reduced area of lateral habitat. Growth was not affected by the greater density of fish in reaches with enhanced lateral habitat. (Author's abstract)
W89-03849

VARIATIONS IN ABUNDANCE OF YOUNG-OF-THE-YEAR CHANNEL CATFISH IN A NAVIGATION POOL OF THE UPPER MISSISSIPPI RIVER,
National Fisheries Research Center, La Crosse, WI.
L. E. Holland-Bartels, and M. C. Duval.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 2, p 202-208, March 1988. 5 fig, 19 ref, 1 tab.

Descriptors: *Population dynamics, *Fish populations, *Mississippi River, *Spawning, *Catfish, *River flow, Fish, Population density, Aquatic habitats, Variability.

Spatial and temporal variations in the abundance of young-of-the-year channel catfish Ictalurus punctatus were determined over 3 years based on 154 trawls taken from Navigation Pool 7 of the upper Mississippi River. No significant spatial patterns in abundance or length of fish in the catch were found in seven poolwide surveys of the main channel. However, high variation among replicates existed. Temporal patterns in abundance and length-frequency distributions varied among the study years. Seasonal catch curves were similar in 1984 and 1986, although offset due to earlier spawning in 1986. Spawning appeared to have been protracted in both years, based on analyses of back-calculated dates of spawn and length-frequency patterns of young. Sixty to seventy percent more young were produced in 1985, when spawning occurred over a shorter period of time and a more uniformly sized year class was produced. These annual variations in year-class characteristics are hypothesized to have resulted in part from different river discharge patterns in the 3 years of the survey, with high discharge in 1984 and 1986 negatively affecting production of young. (Author's abstract)
W89-03850

ROLE OF TURBIDITY IN THE LIMNOLOGY OF LAKE ALEXANDRINA, RIVER MURRAY, SOUTH AUSTRALIA; COMPARISONS BETWEEN CLEAR AND TURBID PHASES,
Adelaide Univ. (Australia). Dept. of Zoology.
M. C. Geddes.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 39, No. 2, p 201-209, 1988. 5 fig, 22 ref.

Descriptors: *Australia, *Turbidity, *Limnology, *Aquatic populations, *Light penetration, *Lakes, Opacity, Suspended solids, Aquatic ecosystems, Lake Alexandrina.

In the first months of 1981, the characteristically highly turbid Lake Alexandrina cleared somewhat so that turbidity dropped from a previous mean value (1975-1978) of 93 NTU to 9 NTU, the Secchi transparency and euphotic depth increased from previous means of 19 cm and 0.8 m to 72 cm and 3.1 m, and the light extinction coefficient fell from 6.54 to 1.2 In units/m. Low flows in the River Murray, especially low contributions from the Darling River, and high salinity which promotes sedimentation, appeared to be the major factors responsible for the clearing. During the clear phase, nutrient levels fell, the normal summer peak of the ulotrichous green alga Planctonema lauterbornei failed to occur, there was a late summer-autumn bloom of blue greens especially Nodularia and Anabaena, and densities of the large microcrustaceans Boeckella triarticula and Daphnia carinata were low. After flushing, the lake turbidity rose to previous high levels and over the period October 1981-April 1982 P. lauterbornei again dominated the phytoplankton, chlorophyll a biomass reached 67 mg/cu m, and the zooplankton community returned to its normal pattern of seasonality and abundance. (Author's abstract)
W89-03854

SEASONAL AND SPATIAL VARIATIONS IN BENTHIC MACROINVERTEBRATE COMMUNITIES OF MAGELA CREEK, NORTHERN TERRITORY,
Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia).
P. M. Outridge.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 39, No. 2, p 211-223, 1988. 4 fig, 3 tab, 35 ref.

Descriptors: *Limnology, *Australia, *Benthic fauna, *Stream biota, *Macroinvertebrates, Seasonal variation, Spatial distribution, Aquatic populations.

Seasonal and spatial patterns of benthic macroinvertebrate communities were examined in four billabongs and a perennial stream riffle in the Magela Creek catchment, Northern Territory. Chironomids, coleopterans, trichopterans and hydracarina were the most diverse and abundant taxa, although the mussel Velesunio angasi contributed > 98% of total standing crop in most billabongs. Diversity and standing crop were usually higher in littoral than in profundal areas of two shallow billabongs, probably because of the presence of macrophytes. Diversity, abundance and biomass declined sharply over the dry season, from maxima in May-July to minima in December. Recovery in the early wet season was rapid, commencing after the first creek flows in December. The decline and recovery were closely associated with the availability of sediment organic matter, which reflected inputs of mainly allochthonous (terrestrial) detritus over the wet season followed by losses due to intense microbial breakdown. Microbial respiration also seemed related to declines in benthic communities in the latter half of the wet season, by producing hypolimnetic anoxia during periods of reduced creek flow. (Author's abstract)
W89-03855

FISH DENSITY VARIATIONS IN THE BRAIDED ASHLEY RIVER, CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Christchurch (New Zealand). Freshwater Fisheries Centre.
G. J. Glova.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 1, p 9-15, 1988. 3 fig, 2 tab, 17 ref.

Descriptors: *Fish populations, *Stream fisheries, *Braided streams, *Rivers, *Population density, Variability, Riffles, Pools, Biomass, New Zealand, Ashley River.

To determine variation in abundance (per sq m) and biomass (g/sq m) of fish populations in the lower Ashley River, New Zealand, a representative reach was sampled by electric fishing during periods of low, stable flows in two consecutive summers (1981 and 1982). For nine species of fish

combined, abundance and biomass in riffles differed by 50% and 41% respectively between the two summers. Size frequency distributions for three of the most common migratory species differed significantly between summers and may partly explain the variation in fish standing stock. Abundance of fish, mostly under 150mm body length, was highest in riffles (3.0/sq m), whereas biomass was highest in pools (46.5 g/sq m) owing to the presence of a few large eels and trout. Within riffles, there was no significant difference in the longitudinal and cross-sectional distributions of the more common fish species present. Both abundance and biomass of fish were lowest in runs, the habitat with the least apparent cover for fish. Limiting sampling of fish populations in braided rivers to riffles, which are easily sampled by electric fishing, provides adequate representation of species composition and temporal variation of their abundance and biomass. (Author's abstract)
W89-03858

LAKE OKARO ECOSYSTEM: 1. BACKGROUND LIMNOLOGY,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 5C.
W89-03859

COMPARATIVE STREAM RESIDENCE OF JUVENILE BROWN AND RAINBOW TROUT IN A SMALL LAKE TRIBUTARY, SCOTTS CREEK, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
J. W. Hayes.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 181-188, 1988. 2 fig, 3 tab, 37 ref.

Descriptors: *Juvenile growth stage, *Trout, *Streams, *Fish behavior, *Fish populations, *Fish migration, *New Zealand, Tributaries, Comparative studies, Ecosystems, Lake Alexandrina.

Species composition, population changes, and emigration of 0+ trout in Scotts Creek, an inlet tributary of Lake Alexandrina, were studied from 1979 to 1982. Trout populations were dominated by late emerging 0+ rainbow trout. Rainbow trout juvenile migration consisted primarily of newly emerged nocturnally migrant fry, whereas that of brown trout was mostly of fish which had undergone a period of stream residence. The pattern of initial downstream migration of early migrants was consistent with a passive dispersal mechanism. Although rainbow trout dominated the 0+ salmonid populations, brown trout made greater proportional use of the stream for rearing. This situation arose from differences in patterns of emigration between the species, particularly that of newly emerged fry, with rainbow trout showing a much greater tendency to emigrate upon emergence. The significance of migratory strategies and interspecific competition in relation to lotic versus lentic rearing of brown and rainbow trout is discussed. (Author's abstract)
W89-03863

PERIPHYTON SAMPLER FOR SHALLOW, SWIFT RIVERS,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 7B.
W89-03864

CHANGES IN THE SUBMERGED MACROPHYTE VEGETATION OF LAKE ROTOITI, CENTRAL NORTH ISLAND, NEW ZEALAND,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 5C.
W89-03866

CONTRASTING DEEP-WATER MACROPHYTE COMMUNITIES IN TWO HIGHLY TRANSPARENT NEW ZEALAND LAKES AND THEIR POSSIBLE ASSOCIATION WITH FRESHWATER CRAYFISH, PARANEPHROPS SPP.,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
B. T. Coffey, and J. S. Clayton.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 225-230, 1988. 2 fig, 2 tab, 10 ref.

Descriptors: *Deep water habitats, *Lakes, *Aquatic plants, *Benthic flora, *Limnology, *Macrophytes, *Crayfish, Transparency, Light penetration, Limiting factors, Chara, Mosses, New Zealand.

Lakes Wanaka and Taupo are both large, deep lakes of comparable water clarity (highly transparent) but composition and depth limit of their deepest rooted macrophyte communities contrast markedly. The macrophyte community in Lake Taupo has a depth limit of 16 m and comprises characean meadows; the macrophyte community in Lake Wanaka has a depth limit of 50 m and comprises a mixed assemblage of bryophytes. A survey of other New Zealand lakes suggested that this deep bryophyte community only occurred in the absence of freshwater crayfish populations. Freshwater crayfish are present in Lake Taupo but not in Lake Wanaka. Bryophytes collected from a depth of 35 m in Lake Wanaka and charophytes collected from a depth of 15 m in Lake Taupo were all successfully established and grown on submerged platforms (which excluded freshwater crayfish) at a depth 35 m in Lake Taupo. It is suggested that in lakes, such as Taupo which have dense crayfish populations, browsing and mechanical damage by crayfish exclude the deep bryophyte community and limit the characean algae to depths shallower than their light compensation point. (Author's abstract)
W89-03867

TRAPPED SEA WATER IN LAKE HAKAPOUA, NEW ZEALAND,
Department of Scientific and Industrial Research, Wellington (New Zealand). Div. of Marine and Freshwater Science.
B. R. Stanton, and R. A. Pickrill.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 293-294, 1988. 1 fig.

Descriptors: *Lake Hakapoua, *Seawater, *Saline water, *Saline-freshwater interfaces, *Lakes, *Bottom water, *Fjords, New Zealand, Landslides, Salinity, Oxygen depletion.

Lake Hakapoua is located on Big River, about 3 km inland from the southern coast of New Zealand. The lake was tidal until it was cut off from the sea by a landslide in 1915. A survey of the lake in February 1987 found that the bottom water below 60 m was saline and apparently anoxic. The bottom waters of the lake had salinity values around 75% of those generally found off this coast. This water has been isolated for some time and may be remnant sea water trapped in the lake at the time of the landslide. Further investigation is needed to positively determine the source of the salinity. (Author's abstract)
W89-03869

LAKE OKARO ECOSYSTEM: 2. PRODUCTION OF THE CHIRONOMID POLYPEDILUM PAVIDUS AND ITS ROLE AS FOOD FOR TWO FISH SPECIES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
D. J. Forsyth, and M. R. James.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 3, p 327-335, 1988. 5 tab, 5 fig, 14 ref.

Descriptors: *Ecosystems, *Lakes, *Midges, *Fish food organisms, Fish food, Food chains, Limnology, Littoral environment, Crustaceans, Smelt, Cyanophyta, Predation.

Lake Okaro, a nutrient-rich lake on the central volcanic plateau of the North Island, New Zealand, supported a maximum littoral population of 309,000 chironomid larvae/sq m in 1983/84. This population depended for food on the shoreward drift of cyanobacteria (blue-green algae). The larvae were an important food source for the benthic bully (Gobiomorphus cotidianus McDowall) from January to June. From June to December the cladoceran (Ceriodaphnia dubia Richard) was prominent in the diet when the fish moved towards the open water of the lake. The bully removed up to 128% of chironomid production only when population density of the larvae was low. At other times fish predation had little impact on the larvae. Most larvae were eaten by bullies during the day. Bullies caught at night were on average larger and preferred to eat small individuals of their own species. The smelt Retropinna retropinna (Richardson) played a minor predatory role in the lake. It ate P. pavidus larvae at all times but favored C. dubia in winter and small bullies in autumn. In Lake Okaro cyanobacterial food supply was of overriding importance to the chironomid population but fish predation was a minor influence. Both fish species were opportunistic feeders switching seasonally to the most readily available prey. (Author's abstract)
W89-03870

RECOVERY OF BENTHIC MACROINVERTEBRATE AND EPILITHIC COMMUNITIES FOLLOWING A LARGE FLOOD, IN AN UNSTABLE, BRAIDED, NEW ZEALAND RIVER,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
G. J. Scrimgeour, R. J. Davidson, and J. M. Davidson.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 3, p 337-344, 1988. 7 fig, 2 tab, 31 ref.

Descriptors: *Macroinvertebrates, *Benthic fauna, *Stream biota, *Population dynamics, *Floods, *Aquatic insects, *Flood damage, Braided streams, Midges, New Zealand.

Benthic macroinvertebrates and small stones were collected from a riffle in the Ashley River, North Canterbury, New Zealand, on 12 occasions within a 132-day period following a particularly large flood in 1986. Despite the occurrence of smaller floods during this period, benthic macroinvertebrate communities and stone surface organic layers recovered rapidly. Mean concentration of stone surface organic carbon increased from 0.23 g/sq m to 1.01 g/sq m stone surface in the first 23 days after the flood and chlorophyll a concentration increased from 0.13 mg/sq m (day 3) to 9.2 mg/sq m by day 132. Minor floods during the recovery period had little effect on organic layer biomass. Mean faunal density increased from 230/sq m to 7920/sq m during this time and taxon richness from 7 to 21 per 5 benthic samples. Immediately after the flood and throughout the study period the fauna was dominated by larvae of Deleatidium (Ephemeroptera: Leptophlebiidae), Hydora (Coleoptera: Elmidae), and Chironomidae. Re-establishment of Deleatidium populations in previously denuded brands was effected by oviposition, egg-hatching, and larval immigration. Minor braids are likely to represent important epicenters from which recolonization proceeds. (Author's abstract)
W89-03871

SURVIVAL OF JUVENILE RING-NECKED DUCKS ON WETLANDS OF DIFFERENT PH,
Patuxent Wildlife Research Center, Orono, ME. Maine Field Station.
For primary bibliographic entry see Field 5C.
W89-03895

FOODS OF JUVENILE RING-NECKED DUCKS: RELATIONSHIP TO WETLAND PH,
Patuxent Wildlife Research Center, Orono, ME. Maine Field Station.
For primary bibliographic entry see Field 5C.
W89-03896

REGIONAL PATTERNS AND LOCAL VARIABILITY OF DRY AND OCCULT DEPOSITION

STRONGLY INFLUENCE SULFATE CONCENTRATIONS IN MAINE LAKES,
Maine Univ., Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W89-03947

LONG-TERM CORRELATIONS BETWEEN THE ABUNDANCE OF SMELT, (OSMERUS EPERLANUS EPERLANUS L.), YEAR CLASSES AND ABIOTIC ENVIRONMENTAL CONDITIONS DURING THE PERIOD OF SPAWNING AND LARVAL DEVELOPMENT IN THE ELBE RIVER,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
D. Borchardt.
Archiv fuer Fischereiwissenschaft AVFSAO, Vol. 38, No. 3, p 191-202, April 1988. 2 fig, 3 tab, 15 ref.

Descriptors: *Fisheries, *Population dynamics, *Environmental effects, *Elre River, *Spawning, *Larvae, *Smelt, Environment, Model studies, Simulation, Fish populations, Water temperature, Flow discharge, Quantitative analysis, Hydrographs, Correlation coefficient, Germany, Rivers, North Sea, Shrimp.

The purpose of this study was to validate a simulation model, on the influence of three basic environmental parameters during the spawning and larval period on the abundance of smelt year classes, based on records compiled for 31 years. After their first year of life, young smelt migrate from the Elbe River into waters along the German North Sea Coast. There, the smelt form part of the bycatch of the commercial shrimp fishery. It was assumed that the number of young smelt in the by catch reflect the strength of year class I. The environmental conditions for the smelt spawning ground in the Elbe River during the spawning and larval periods, were correlated with the numbers of/ smelt in the bycatch of the German shrimp fishery on the North Sea tidal flats along the Schleswig-Holstein and the Lower Saxony Coast. The correlation between the bycatch on the coast of Schleswig-Holstein and the environmental index proved to be significant for the one year old smelt for the period from 1954 to 1984. (Author's abstract)
W89-03973

CHLORELLA VIRUSES ISOLATED IN CHINA,
Nebraska Univ.-Lincoln. Dept. of Plant Pathology.
Y. Zhang, D. E. Burbank, and J. L. Van Etten.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2170-2173, September 1988. NIH Public Health Service Grant GM-32441; US DOE Grant DE-ACO2-82ER12086.

Descriptors: *Aquatic life, *Viruses, *Chlorella, *China, *Microbiological studies, Chloroform, Proteins.

Plaque-forming viruses of the unicellular, eucaryotic, exsymbiotic, Chlorella-like green algae strain NC64A, common in the United States, have been detected in fresh water collected in the People's Republic of China. Seven of the Chinese viruses were examined in detail and compared with the Chlorella viruses previously isolated in the United States. Like the American viruses, the Chinese viruses were large polyhedra and sensitive to chloroform. They contained numerous structural proteins and large double-stranded DNA genomes of at least 300 kilobase pairs. Each of the DNAs from the Chinese viruses contained 5-methyldeoxycytosine, which varied from 12.6 to 46.7% of the deoxycytosine, and N6-methyldeoxyadenosine, which varied from 2.2 to 28.3% of the deoxyadenosine. Four of the Chinese virus DNAs hybridized extensively with DNA from the American virus PBCV-1, and three hybridized poorly. (Author's abstract)
W89-04001

CALCULATION OF CELL PRODUCTION FROM (H3)THYMIDINE INCORPORATION WITH FRESHWATER BACTERIA,
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
For primary bibliographic entry see Field 7B.
W89-04004

HYDROLOGIC AND SUSPENDED-SEDIMENT DATA FOR REELFOOT LAKE, OBION AND LAKE COUNTIES, NORTHWESTERN TENNESSEE, MAY 1985-SEPTEMBER 1986,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04039

CLIMATIC DATA FOR MIRROR LAKE, WEST THORNTON, NEW HAMPSHIRE, 1985,
Geological Survey, Lakewood, CO. Water Resources Div.
A. M. Sturrock, D. C. Buso, J. L. Scarborough, and T. C. Winter.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-682, 1988. 64p, 3 fig, 4 tab, 3 ref.

Descriptors: *Limnology, *Evaporation, *Climate data, *New Hampshire, Heat budget, Mirror Lake, Lakes, Climatology.

Research on the hydrology of Mirror Lake, West Thornton, New Hampshire, includes a study of evaporation. Those climatic data needed for energy-budget and mass-transfer evaporation studies are presented, including: water surface temperature, dry-bulb and wet-bulb air temperatures, vapor pressure at and above the water surface, wind speed, and short- and long-wave radiation. Data are collected at raft and land stations. (USGS)
W89-04045

TECHNIQUE FOR MAKING FIELD MEASUREMENTS OF OXYGEN IN THE ROOT ZONE OF SATURATED AND UNSATURATED SOILS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04096

ORGANOCHLORINE PESTICIDE AND PCB RESIDUES AT FOUR TROPHIC LEVELS IN THE SCHUYLKILL RIVER, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04099

DETERMINATION OF AQUATIC HUMIC SUBSTANCES IN NATURAL WATERS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04102

GROUND-PENETRATING RADAR STUDY OF THE THICKNESS AND EXTENT OF SEDIMENTS BENEATH SILVER LAKE, BERLIN AND MERIDEN, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04107

RETENTION TIME AND FLOW PATTERNS IN LAKE MOULTRIE, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
G. G. Patterson, and R. M. Harvey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4121, 1986. 32p, 20 fig, 4 tab, 3 ref.

Descriptors: *Dye dispersion, *Dye releases, *Lakes, *Water circulation, *Tracers, *South Carolina, Wind-driven currents, Water currents, Retention time, Berkeley County.

A liquid dye tracer was injected into the inflow to Lake Moultrie, South Carolina, during high-flow conditions and again during low-flow conditions. Tracer concentrations were monitored at a network of fixed sampling stations in the lake to determine dispersion and transport characteristics in and through the lake. Wind-generated currents were the major factor in dispersing the tracer and controlling the flow patterns, with the advective flow of water through the lake a secondary contributing factor. During the high-flow test, most of the tracer was flushed through the lake in 12 days, which did not allow time for the tracer to fully disperse throughout the lake. During the low-flow test, most of the tracer remained in the lake for more than a of a month. After 16 days it was dispersed throughout the lake. Concentrations of tracer decreased by a factor of about 500 as the dye clouds passed through the lake. (USGS)
W89-04108

ESTIMATED SEDIMENT DEPOSITION IN LAKE CORPUS CHRISTI, TEXAS, 1972-85,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-04136

CLIMATIC DATA FOR THE COTTONWOOD LAKE AREA, STUTSMAN COUNTY, NORTH DAKOTA, 1983,
Geological Survey, Lakewood, CO. Water Resources Div.
A. M. Sturrock, B. A. Hanson, J. L. Scarborough, and T. C. Winter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-216, 1987. 28p, 3 fig, 4 tab, 3 ref.

Descriptors: *Limnology, *North Dakota, *Wetlands, *Prairie wetlands, *Climatic data, Evaporation, Heat budget, Cottonwood Lake.

Research on the hydrology of the Cottonwood Lake area, Stutsman County, North Dakota, includes study of evaporation. Climatic data needed for energy-budget and mass-transfer evaporation studies that were collected during 1983 include water-surface temperature, sediment temperature, dry-bulb and wet-bulb air temperature, vapor pressure at and above the water surface, wind speed, and short-and long-wave radiation. Data are collected at raft and land stations. (USGS)
W89-04143

HYDROLOGIC DATA FROM THE INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS, NEW YORK - OCTOBER 1977 THROUGH JANUARY 1982,
Geological Survey, Albany, NY. Water Resources Div.
N. E. Peters, P. S. Murdoch, and F. N. Dalton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-80, 1987. 146p, 7 fig, 4 tab, 5 ref.

Descriptors: *Acid rain, *Data collections, *Lakes, *Hydrologic data, *Water quality, *Adirondack Mountains, *New York, Forest watersheds, Lake basins, Groundwater, Soil water, Soil temperature, Snow surveys, ILWAS.

Hydrologic data were collected from three forested headwater lake watersheds in Herkimer and Hamilton Counties from October 1977 through early January 1982 as part of the Integrated Lake-Watersheds Acidification Study (ILWAS). ILWAS was established in 1977 to determine why these lakes differ in pH when all receive equal amounts of acidic atmospheric deposition. Woods Lake is acidic (pH ranges from 4 to 5), Panther Lake is neutral (pH ranges from 5 to 7.5), and Sagamore Lake is intermediate (pH ranges from 5 to 6). The data tabulated herein include discharge at the three lake outlets and in a tributary to each lake; lake-water stage at each lake; chemical qual-

ity of lake water, including total concentrations of zinc, iron, manganese, and lead, at each lake outlet and at Lost Brook (a tributary to Sagamore Lake); groundwater stage from 29 wells; major ion concentrations of groundwater from 22 of these wells; temperature of soil from three depths at one site in each watershed; soil-moisture tension at three depths at eight sites - four in the neutral-lake basin, three in the acidic-lake basin, and one in the intermediate-lake basin; and average snowpack depths and water equivalents at approximately 20 snow-course sites in each basin for three sampling periods during the 1979-80 winter. (USGS)
W89-04161

WATER QUALITY OF FREMONT LAKE AND NEW FORK LAKES, WESTERN WYOMING - A PROGRESS REPORT,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04180

CONSIDERATION OF CHANGES IN THE LOCAL CLIMATE IN THE REGION OF THE RESERVOIR AND LOWER POOL OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 6G.
W89-04220

PROCESSES OCCURRING IN RESERVOIRS RECEIVING BIOGENIC AND POLLUTING SUBSTANCES,
For primary bibliographic entry see Field 5C.
W89-04221

RECREATIONAL USE OF THE RESERVOIRS OF HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
V. A. Kukushkin, M. F. Skladnev, and M. P. Fedorov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 593-598, April 1988. 3 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 23-25, October 1987.

Descriptors: *Reservoirs, *Project planning, *Recreation facilities, *Hydroelectric plants, *Pumped storage, *Soviet Union, Human population, Climate, Aquatic animals, Regulated flow, Hydrological regime, Multipurpose projects, Economic justification.

Of the 200 large hydroelectric station reservoirs of the USSR, more than 60 are used for recreation. Twenty-seven million people live in cities located directly on the shores of reservoirs and an additional 50 million people live within a 2-h drive. Climatic, landscape, hydrological, sanitary/hygienic conditions, and the presence of aquatic fauna are taken into account when evaluating the suitability of a reservoir for recreation. Planning of favorable types of recreation on reservoirs located in various natural and climatic zones requires a climatological study. Streamflow regulation and the creation of reservoirs substantially change the hydrological regime of a stream and fluctuations of the reservoir level can be a serious obstacle for its recreational use. When developing water-management and hydropower-construction projects or schemes for multipurpose use of undammed streams, special attention should be devoted to the problem of future recreational use. Because of the importance of this problem, a special section of the project should be devoted to recreational development with mandatory elucidation of the natural, hydrological, sanitary/hygienic, and engineering/technical problems. There should also be an economic justification of the proposed recreational measures with an evaluation of their consequences with estimation not only of costs but also of the payback period and effectiveness in the recreational development of the region. (Shidler-PTT)
W89-04224

SURFACE-DRIVEN FLOWS IN LONG RECTANGULAR ENCLOSURES,
Centre National de la Recherche Scientifique, Marseille (France). Inst. de Mecanique des Fluides de Marseille.
For primary bibliographic entry see Field 8B.
W89-04241

ORGANIC MATTER DYNAMICS IN FOUR SEASONALLY FLOODED FOREST COMMUNITIES OF THE DISMAL SWAMP,
Savannah River Ecology Lab., Aiken, SC. Div. of Wetlands Ecology.
J. P. Megonigal, and F. P. Day.
American Journal of Botany AJBOAA, Vol. 75, No. 9, p 1334-1343, September 1988. 4 fig, 3 tab, 46 ref, append. NSF grants DEB-7708609, DEB-7708609-A01, and BSR-8405222 and Department of Energy contract DE-AC09-76SR00-819.

Descriptors: *Swamps, *Forests, *Flooding, *Data interpretation, Organic matter, Dynamics, Primary productivity, Biomass, Plant populations, Roots, Litter, Detritus, Data collections, Model studies, Dismal Swamp.

Organic-matter budgets for plant communities of the Great Dismal Swamp were developed to summarize an extensive database, determine patterns of biomass allocation, transfer, and accumulation, and make comparisons with other forested wetlands. Aboveground net primary production on the flooded sites (1050-1176 g/sq m/yr) was significantly greater than on a rarely-flooded site (831 g/sq m/yr). Estimates of belowground net primary production were comparable to aboveground production on flooded sites (824-1221 g/sq m/yr). However, production was nearly 3 times greater belowground than aboveground on the rarely-flooded site (2256 g/sq m/yr). Aboveground productivity in Dismal Swamp forests is relatively high compared to other forested wetlands. This is attributed to the timing and periodicity of floods. Fine-root turnover was shown to be an important source of soil organic matter. Estimates indicate that roots contribute about 60% of the annual increment to soil organic matter. Leaf litter contributes 6-28% and wood debris contributes 5-15%. Comparisons with other forested wetlands suggest that detritus accounts for more than half the total organic matter (living + dead) in many wetland systems. Models based on the organic-matter budgets presented here have been developed and offer additional insight into system dynamics. (Author's abstract)
W89-04245

MICRO AND LARGE-SCALE PARAMETERS EVALUATION OF EVAPORATION FROM A LAKE,
Athens Univ. (Greece). Lab. of Meteorology.
For primary bibliographic entry see Field 2D.
W89-04268

OBJECTIVES AND UNSOLVED PROBLEMS IN ECOTECHNOLOGY AND BIOMANIPULATION: A PREFACE,
For primary bibliographic entry see Field 5G.
W89-04304

RELATIONSHIP BETWEEN ZOOPLANKTON BIOMASS AND GRAZING: A REVIEW,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-04305

CAN DAPHNIA PREVENT A BLUE-GREEN ALGAL BLOOM IN HYPERTROPHIC LAKES,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W89-04306

RESTORATION OF THE PELAGIC FOOD WEB IN ACIDIFIED AND LIMED LAKES BY GENTLE FERTILIZATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5G.
W89-04307

UNPLANNED BIOMANIPULATION IN LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 5G.
W89-04308

TROPHIC INTERACTIONS IN THE HYPERTROPHIC LAKE TJEUKEMEER: TOP-DOWN AND BOTTOM-UP EFFECTS IN RELATION TO HYDROLOGY, PREDATION AND BIOTURBATION DURING THE PERIOD 1974--1985,
Limnologisch Inst., Oosterzee (Netherlands).
For primary bibliographic entry see Field 5G.
W89-04309

APPLICABILITY OF THE FOOD-WEB MANIPULATION IN THE RESTORATION PROGRAM OF A HYPERTROPHIC STRATIFIED LAKE: MODEL STUDIES FOR LAKE HAUSSEE (FELDBERG, GDR),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
For primary bibliographic entry see Field 5G.
W89-04310

USING STREAM SURVEY DATA TO PREDICT DIRECTIONAL CHANGE IN FISH POPULATIONS FOLLOWING PHYSICOCHEMICAL STREAM PERTURBATIONS,
Kansas Dept. of Wildlife and Parks, Pratt. Environmental Services Section.
For primary bibliographic entry see Field 5C.
W89-04336

SURFACE FILMS AND MIXING IN TWO-LAYER FLUID,
Western Australia Univ., Nedlands. Centre for Water Research.
A. Dittrich.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1359-1375, November 1988. 14 fig, 1 tab, 24 ref.

Descriptors: *Fluid dynamics, *Boundary processes, *Surface tension, *Limnology, *Shear stress, *Mixing, Surface water, Flow pattern, Surface flow, Entrainment, Turbulent flow, Flow channels, Velocity, Density, Wind velocity, Lakes.

An experimental investigation of wind-induced flow and mixing processes in a two-layered system influenced by a thin film persisting on the water surface is reported in this study. Detailed documentation and description of the wind-induced flow and mixing processes are given. The entrainment rates and flow pattern depend on two dimensionless numbers, one characterizing the influence of surface films, the other characterizing the response of stratified basins to wind stress in the absence of surface films. The differences between the flow and mixing processes of a two-layered system influenced and not influenced by a surface film are pointed out and discussed. (Author's abstract)
W89-04361

LAKE ACIDITY AND THE DISTRIBUTION AND ABUNDANCE OF WATER STRIDERS (HEMIPTERA: GERRIDAE) NEAR SUDBURY, ONTARIO,
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W89-04387

WATER WAVES GENERATED BY DISTANT LANDSLIDES,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 307-322, 1988. 5 fig, 18 ref, append.

Descriptors: *Reservoirs, *Landslides, *Waves, *Model studies, Wave runup, Sloping beaches, Mathematical analysis.

Waves generated in a reservoir by a landslide were modeled by injecting an instantaneous point source of fluid through the bottom of a reservoir of infinite extent. This assumes that times are large relative to the duration time of the landslide and that distances are large relative to the characteristic horizontal dimension of the volume of water displaced by the slide material. Solutions are obtained for two-dimensional and asymmetric problems, and the characteristics of each are discussed. Since the solutions assume a constant reservoir depth, and since maximum wave amplitudes always occur along shorelines of sloping beaches, it is suggested that these solutions may be of most use for providing boundary conditions for models of wave runup on sloping beaches. In a comparison with experimental results agreement between the calculated and measured results was good. (Author's abstract)
W89-04420

SEASONAL ASPECTS OF POTENTIAL LIMITATION BY N, P AND FE ON PHYTOPLANKTON IN BARRA BONITA RESERVOIR (RIVER TIETE, SP) (ASPECTOS SAZONAIS DA LIMITACAO POTENCIAL POR N, P, E FE NO FITOPLANCTON DA REPRESA DE BARRA BONITA (RIO TIETE, SP)),
Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
R. Henry, and C. A. Simao.
Revista Brasileira de Biologia RBBIAL, Vol. 48, No. 1, p 1-14, February 1988. 5 fig, 1 tab, 36 ref. FAPESP proc. 83/2451, 83/1428-7, and 83/2452-9 and CNPq proc. 40524/83. English summary.

Descriptors: *Eutrophication, *Reservoirs, *Phytoplankton, *Limiting nutrients, *Enrichment, *Brazil, *Phosphates, Nitrates, Iron, Chlorophyll a, Primary productivity, In situ tests.

Measurement of artificial-enrichment effects on surface phytoplankton was carried out over a one-year period in Barra Bonita Reservoir. Chlorophyll a and phaeophytin, phytoplankton primary production in enriched samples, and dissolved inorganic nutrient content were measured after 3 and 10 days of in-situ incubation. For the whole year, phosphate was the stimulator nutrient of phytoplankton growth. The response to phosphate addition was quick (after the 3d day) in the experiments of March, April-May, and September 1984 and January 1985 but it occurred only after the 10th day in June and November 1984. Nitrate addition, alone or with phosphate, had no stimulator effect. Throughout the year, the role of nitrogen as a limiting factor was very small. The action of iron, as a stimulator agent, was not significant. (Author's abstract)
W89-04437

FISHES OF MURPHY'S POND, A CYPRESS SWAMP IN WESTERN KENTUCKY,
Murray State Univ., KY. Dept. of Biological Sciences.
T. J. Timmons.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 49, No. 1/2, p 21-25, March 1988. 1 fig, 1 tab, 8 ref.

Descriptors: *Swamps, *Ponds, *Fish, *Baseline studies, *Kentucky, Species composition, Fish populations, Pike, Killifish, Sunfish, Catfish, Lamprey, Bowfin, Black bass, Fish diets, Channeling, Water table decline.

The objectives of this study were to determine the species of fishes present in Murphy's Pond and their relative abundance. Twenty-seven species of fishes were collected from 1984 to 1986. Seven additional species have been reported from previous collections. The Kentucky distribution of 4 (Esox niger, Fundulus dispar, Lepomis marginatus, L. symmetricus) is restricted to the extreme western part of the state, and 1 (Ictalurus nebulosus) is poorly represented in state collections. Three species from Murphy's Pond have been listed as threatened (Erimyzon sucetta) or endangered in Kentucky (Fundulus dispar, Lepomis marginatus). The greatest percentage of fish biomass consisted of predators such as Amia calva, Esox niger, Micropterus salmoides, and catfishes (Ictalurus melas, I. natalis, I. nebulosus). Amia calva stomachs contained mostly crayfish, but also fish and amphibians, while those of Esox niger and Micropterus salmoides contained only fishes. Murphy's Pond is managed by Murray State University and the fish fauna receives little direct disturbance or perturbation. The greatest probable dangers to this swamp are siltation and further channelization of nearby Obion Creek. If the channelized creek is deepened, the lower water table could significantly lower the water level. Much of the pond is already shallow and a lowered water level would greatly reduce the surface area. (Shidler-PTT)
W89-04440

SIGNIFICANCE OF AQUATIC SURFACE RESPIRATION IN THE COMPARATIVE ADAPTATION OF TWO SPECIES OF FISHES (NOTROPIS CHRYSOCEPHALUS AND FUNDULUS CATENATUS) TO HEADWATER ENVIRONMENTS,
Centre Coll. of Kentucky, Danville. Div. of Science and Mathematics.
M. Barton, and K. Elkins.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 49, No. 3/4, p 69-73, September 1988. 2 fig, 1 tab, 18 ref.

Descriptors: *Stream biota, *Shiner, *Killifish, *Respiration, *Headwaters, Fish behavior, Fish physiology, Survival, Adaptation, Oxygen uptake, Oxygen depletion, Kentucky.

A common behavioral response of fishes exposed to hypoxic conditions is to move to the surface and breathe the thin film of richly-oxygenated water there. Rates of dissolved oxygen consumption and capacity for aquatic surface respiration were measured for 2 species of fishes, the common shiner (Notropis chrysocephalus) and the northern studfish (Fundulus catenatus), common in headwater streams of the North Rolling Fork River, Kentucky. While both species assumed the body position characteristic of oxygen uptake at the water surface, the depletion of atmospheric oxygen within a respirometer was greater for F. catenatus, suggesting a more-efficient mode of surface breathing under conditions of hypoxia. The survival times of both species were enhanced with access to atmosphere. Different strategies for coping with hypoxic conditions in the 2 species are apparent. The northern studfish maintains aerobic metabolic capacity through efficient aquatic surface respiration while the common shiner may increase anaerobic metabolism under conditions of hypoxia. Both species possess the requisite physiological capacities for survival in headwater stream systems subject to intermittent flow regimes. (Author's abstract)
W89-04442

EXPERIMENTAL STUDIES OF CHEMICAL STRESSORS ON WHOLE LAKE ECOSYSTEMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W89-04478

LABORATORY STUDIES ON THE INITIATION OF DENSITY CURRENTS BY INFLOWS TO LAKES AND RESERVOIRS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, T. R. Johnson, C. R. Ellis, G. J. Farrell, and J. Akiyama.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 58-61, January 1988. 1 fig, 12 ref.

Descriptors: *Density currents, *Lakes, *Reservoirs, *Limnology, Influent water, Water currents, Streamflow, Flow, Flumes, Channels, Density, Profiles, Entrainment, Jets, Water quality, Froude number, Sediment transport.

The transition from a stream flow to a submerged density current in a lake or reservoir was investigated in the laboratory for several inflow geometries and conditions. The phenomenon, also called plunging flow, occurs when the inflow is of greater density than the receiving lake or reservoir water. Experiments in laterally confining laboratory flumes have confirmed the behavior of sinking inflows. Prediction of the location of the plungeline and of the depth to which density currents will sink in a lake or reservoir are necessary for water quality forecasts. Earlier investigations focused on the experimental determination of a densimetric Froude number at the plunge location. The Froude number varies with the geometry of the transition from the channel or stream to the lake or reservoir. In first approximation, the geometry can be thought of as a rectangular diffuser. The flow in such a diffuser can be a channel flow confined by the walls when the slope or divergence angle is small, or it can be a jet flow (wall jet or free jet) when the divergence angle is large enough as the result of flow separation. Experimental information on plunge location is provided for both attached or separated types of flows. (Author's abstract)
W89-04479

HYPOLIMNIC MIXING IN A DEEP ALPINE LAKE AND THE ROLE OF A STORM EVENT,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
D. M. Imboden, B. Stotz, and A. Wuest.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 67-73, January 1988. 5 fig, 1 tab, 7 ref.

Descriptors: *Limnology, *Mixing, *Hypolimnion, *Lakes, *Alpine regions, *Storms, Wind, Oxygen, Thermal stratification, Water temperature, Physical properties, Conductivity, Internal waves, Switzerland.

Results are presented of a physical field program to identify and quantify the mixing mechanisms in the hypolimnion of Lake Zug, a deep alpine lake in Zurich, Switzerland. Vertical profiles of water temperature and electrical conductivity were measured every two weeks at five stations. Total temperature changes were less than 0.1 K, and less than 0.01 K below 100 m. Within a few hours after a severe storm on November 7, 1982, water from 20 m and below was exposed to the surface at the south end of the lake, while at the other end, water from 18 m (8 C isotherm) temporarily dropped below 44 m. After the storm, internal waves of large amplitude remained in the lake for more than 10 days. It is concluded that the effect of the storm on the long-term water exchange in the deep hypolimnion of Lake Zug is enormous. The behavior of the water column and the eventual restoration of the density stratification show that 'turnover' events can occur in a lake without permanent destruction of the stratification. Interpretation of isolated temperature profiles in terms of lake mixing should be made cautiously if storm events precipitate such measurements. (Doria-PTT)
W89-04480

REGAINED, BUT HIDDEN HOLOMIXIS OF THE AUSTRIAN LAKE TRAUNSEE,
Innsbruck Univ. (Austria). Dept. of Limnology.
C. Sossau, and R. Pechlaner.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 74-79, January 1988. 3 fig, 1 tab, 12 ref.

Descriptors: *Water pollution effects, *Holomictic lakes, *Austria, *Stratification, *Limnology, Meromixis, Mixing, Water temperature, Physical properties, Chemical properties, Chlorides, Sulfates, Vertical distribution, Conductivity.

Lake Traunsee (Austria) has been known as an example of artificially induced meromixis, caused by the input of large quantities of soluble wastes. However, the evaluation of an almost complete set of data on the vertical distribution of temperature,

conductivity, chloride, and oxygen concentration measured monthly at a maximum depth since 1942, and a rather detailed limnological study from 1972 to 1982, showed that the meromixis of Lake Traunsee must have been a rather short episode. The lake has been holomictic (warm monomictic) again at least since 1951. In each winter between 1951 and 1981, the water body below 100 m gained oxygen, the highest content being about 1.4 mg/l above the annual oxygen minimum. The highest gains were observed in 1951 (2.4 mg/l) and 1980 (2.5 mg/l), the lowest in 1966 (0.7 mg/l). The loss of oxygen during summer stagnation is in the same range (0.9-2.3 mg/l, mean 1.5 mg/l). Due to considerable vertical differences in the concentrations of chloride and sulfate, a constant vertical density gradient has been observed in Traunsee. Holomixis in late winter is inconsistent with retained differences between surface and deep water, equivalent to conductivity differences of about 150 micros. But this discrepancy can be explained by the constant addition of chlorides and sulfates from industrial wastes to the surface waters of Traunsee: The input of 10,000 tons of chloride/month is an appropriate figure for the most recent years of the present study. Preliminary observations showing a rise in chloride and sulfate as well as low oxygen concentrations in the outlet stream in late winter support the idea of a 'conveyor belt' type of deep mixing, and more detailed studies have been initiated to test this phenomenon. (Doria-PTT)
W89-04481

FREQUENCY AND DEPTH OF VERTICAL MIXING IN AN AMAZON FLOODPLAIN LAKE (L. CALADO, BRAZIL),
California Univ., Santa Barbara. Dept. of Biological Sciences.
S. MacIntyre, and J. M. Melack.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 80-85, January 1988. 5 fig, 8 ref. NSF Grants DEB 78-23642, DEB 81-11398, and BJR-0794.

Descriptors: *Brazil, *Amazon River, *Flood plains, *Lakes, *Mixing, *Limnology, Wind, Stratification, Thermocline, Nutrients, Methane, Zones, Euphotic zone, Meteorological data collection.

Variations are presented of the depth of the thermocline and oxycline determined from 500 temperature and oxygen profiles taken over a period of three years in Lake Calado, a moderately-sized lake in the Amazon floodplain. Lake Calado is similar to other lakes in the central Amazon floodplain in that it is seasonally inundated and stratifies once its depth exceeds 6 m. Stratification persists for 6 to 9 months of the year, and elevated concentrations of ammonium, phosphate, and methane occur below the thermocline. Nutrient supply rates to the euphotic zone and methane emission to the atmosphere are determined by the frequency of mixing events which entrain the hypolimnetic waters. It is concluded that entrainment occurs in Lake Calado when subtle shifts occur in the balance between net incoming radiation, sensible heat exchange, evaporative cooling, and in mechanical wind energy. For this reason, predicting mixing depths requires complete meteorological data. (Author's abstract)
W89-04482

SEASONAL HYDRODYNAMIC CYCLES IN LAKE TANGANYIKA,
Rhodes Univ., Grahamstown (South Africa). Dept. of Ichthyology.
G. W. Coulter.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 86-89, January 1988. 3 fig, 14 ref.

Descriptors: *Seasonal variation, *Hydrodynamics, *Lakes, *Lake Tanganyika, *Limnology, Meromixis, Water temperature, Physical properties, Density stratification, Rainfall, Weather, Data collections.

Limnological data were gathered at different times in the four countries that share Lake Tanganyika in order to investigate the lake's hydrodynamic cycles. Lake Tanganyika is a long (650 km), very deep, meromictic lake. Density stratification is determined by the vertical temperature structure which ranges from 23.25 C to about 27.25 C. A 'dry season' from May through August is characterized by strong south wind along the main axis. In the rest of the year ('wet season'), there are rainy periods and winds are generally light and mainly northerly. Significant thermal changes in the upper 250 m correspond with these seasons although air temperatures vary little. Meteorological data are scanty, but seasonal heat loss from the lake is probably the result of evaporative cooling by the relatively dry south wind, as in the neighboring lakes, Victoria and Malawi. (Author's abstract)
W89-04483

VARIATION OF WATER BALANCE OF LAKE MASHU:A CLOSED VOLCANIC LAKE IN JAPAN,
National Inst. for Environmental Studies, Yatabe (Japan).
Y. Ambe, S. Horiuchi, and T. Kawai.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 90-95, January 1988. 5 fig, 5 ref.

Descriptors: *Closed lakes, *Hydrologic budget, *Lake Mashu, *Japan, *Limnology, Seepage, Rainfall, Evaporation, Water level, Leakage, Hydraulic gradient, Lava, Geologic formations.

A study was conducted to analyze the annual variation of water balance in Lake Mashu and to characterize the hydrological process in response to rainfall. Lake Mashu is a seepage lake formed in a caldera in Hokkaido, Japan. It was found that the small annual change of lake level is due to the smallness of the intake area and the relatively high leakage. A rapid rise and two types of decrease were characteristic. One is a slow seepage, 1-5 mm/day, which increases at the higher stage and decreases at the lower stage, giving 351.15 m as the critical level. This indicates that the seepage occurs mainly around that level, where the boundary of lava and tuff is found. The other is the rapid seepage right after rain, averaging 4 mm/hr. This type is explained by the increase of partial hydraulic gradient caused by the rapid rise of water surface. It is concluded that the water balance of this lake is mainly influenced by geological conditions, rainfall, and water level. As a result, the observed lowering of water level in 1984 was probably caused by a rainfall deficit. (Author's abstract)
W89-04484

GEOTHERMAL DENSITY CURRENT,
Electricorp, Hamilton (New Zealand).
I. M. Johnstone, D. Harding, and R. D. S. Robertson.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 96-102, January 1988. 2 fig, 2 tab, 18 ref.

Descriptors: *Reservoirs, *Path of pollutants, *Geothermal power, *Density currents, *Limnology, Conductivity, Water temperature, Mixing, Turbulent flow, Buoyancy, New Zealand, Dissolved solids, Arsenic, Boron.

The behavior of a small, but environmentally important, density current in Lake Aratiatia, a hydroelectric reservoir in New Zealand, is described. Geothermal fluid from the Wairakei bore field, which contains high concentrations of dissolved salts, is discharged into Lake Aratiatia and is significantly denser than the lake water when both are at the same temperature. The Wairakei Stream carries arsenic and boron into the Waikato River and is thus of environmental concern. Although the Wairakei Stream does not form a buoyant thermal plume, discussions concerning possible environmental effects of the stream have ususally assumed that it does form a classic thermal plume. The geothermal fluid enters the lake at a temperature of 59 C, which is, depending on the season, approximately 40-50 C warmer than the lake water. On entering the lake, the fluid initially floats, but as it cools to a temperature approximately 10 C warmer than the lake it sinks, forming a density current that rapidly mixes with the lake water as a result of interface instabilities (at high lake-water current velocities) or by turbulent diffusion (at low lake-water current velocities). Because of the density differences of the two waters and resulting density currents, flow of geothermal water into Lake Aratiatia does not result in the formation of a buoyant overflow. (Doria-PTT)
W89-04485

BAULE-MITSCHERLICH LIMITING FACTOR EQUATION EVALUATED IN FRESHWATER HABITATS,
Southern Illinois Univ., Carbondale. Dept. of Botany.
J. Verduin.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 103-105, January 1988. 4 ref.

Descriptors: *Limiting factors, *Aquatic environment, *Mathematical equations, *Lakes, *Limnology, Eutrophication, Nitrogen, Carbon, Phosphorus, Euphotic zone, Chlorophyll, Phytoplankton, Metabolism.

A slightly modified version of the Baule-Mitscherlich limiting factor equation was evaluated for freshwater lakes sampled in the U.S. Environmental Protection Agency's National Eutrophication Survey. The four factors were N, P, C, and light. N and P were expressed in mg/L, C as titratable base (meq/L), and light supply as the ratio of euphotic zone thickness to mean depth. A term is provided for indicating the departures of the observed chlorophyll values from those predicted by the equation. The equation can also be used to predict phytoplankton volume, photosynthetic yield, areal photosynthesis, and community metabolism. (Author's abstract)
W89-04486

SEASONAL DYNAMICS OF SULFATE AND HYDROGEN SULFIDE NEAR THE SEDIMENT-WATER INTERFACE OF AN OLIGOTROPHIC LAKE,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 106-115, January 1988. 2 fig, 2 tab, 26 ref.

Descriptors: *Sulfates, *Hydrogen sulfide, *Sediment-water interfaces, *Oligotrophic lakes, *Acid rain, *Sulfur cycle, Seasonal variation, Lakes, Acidic water, Interstitial water, Profiles, Temperature, Oxygenation, Sulfur, Oxidation, Limnology, Dynamics.

The widespread occurrence of anthropogenic lake acidification in Europe and Eastern North America has stimulated much research aimed at understanding the fundamental biogeochemical processes involved in order to model the response of lakes to increased acid loading. The seasonal evolution of porewater sulfate and H2S (including HS-) was studied in the shallow and hypolimnetic sediments of an oligotrophic acid lake in Quebec Province. At both sites, the porewater profiles are characterized by a pronounced seasonal and horizontal variability. The sulfate profiles of the shallow station indicate flux to the sediment during summer and winter, and from the sediment during spring and fall. At the deeper station, the profiles indicate sulfate flux to the sediment during summer, fall, and winter, and sulfate release from the sediment shortly after spring turnover. H2S usually shows a maximum concentration of 0.2-8 micromol/l located at the level of sulfate reduction in the sediment column. The estimated minimum annual diffusive sulfur flux to the sediment is 3-4 times higher than the present rate of total S accumulation. The pronounced seasonal and horizontal variability in sul-

fate profiles, and the discrepancy between calculated and measured S flux to the sediment suggest that porewater studies may not be appropriate to quantitative estimations of sulfate reduction in this type of lake. (Author's abstract)
W89-04487

HYPOTHESIS TO EXPLAIN THE COLLOIDAL DIFFERENCES BETWEEN THE UPPER AND LOWER INYO CRATER LAKES,
Claremont Colleges, CA. Joint Science Dept.
C. H. Eriksen, A. W. Zanella, and M. H. Nys.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 116-120, January 1988. 1 fig, 2 tab, 3 ref.

Descriptors: *Colloids, *Lakes, *Inyo Crater Lakes, California, Craters,Carbon, Organic carbon, Carbon dioxide, Acidity, Benthos, Aquatic life, Mixing, Ice, Humic acids, Fulvic acids, Hydrogen ion concentration, Sedimentation, Chemical precipitation.

The Inyo Crater Lakes are located east of the Sierra Nevada escarpment in east-central California. The water in the lower (southern) crater is a colloidal pea-soup green, while the lake in the upper basin is almost never colloidal. The reason for this was investigated. The upper lake's organic-rich sediments support a larger benthic community, producing more CO2 per sq m of lake bottom than in the lower lake. When held in by ice, the effect of this CO2 and the greater amount of humic substances in lowering pH would be proportional to buffering capacity and water volume. Although both lakes are poorly buffered, the upper lake has nearly twice the buffering capacity, but its greater quantities of acidic materials are effective in a water volume only 12% that of the lower lake. Winter sampling demonstrated that CO2 does accumulate and pH lowers to a greater extent in the upper lake. Therefore, given 5 months of ice cover and the development of a critically lower pH in the upper lake, its colloids precipitate out to a significant degree. Thus, when the ice cover melts in the spring, upper lake waters are essentially clear, while the lower lake is as colloidal as before. (Author's abstract)
W89-04488

IRON, MOLYBDENUM AND PHOSPHORUS LIMITATION OF N2 FIXATION MAINTAINS NITROGEN DEFICIENCY OF PLANKTON IN THE GREAT SALT LAKE DRAINAGE (UTAH, USA),
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
W. A. Wurtsbaugh.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 121-130, January 1988. 5 fig, 3 tab, 28 ref. NSF Ocean Sciences grant OCE 8500740.

Descriptors: *Iron, *Molybdenum, *Nitrogen *Limnology, *Phosphorus, *Limiting,nutrients, *Plankton, *Great Salt Lake, Heavy metals, Nutrients, Lake, Environment, Lentic environment, Algae, Growth, Nitrates, Chlorophyll a, Ammonia, Enzymes, Catchment areas.

Factors that control algal production in three contrasting lentic systems located in the Great Basin of North America are described. Bioassays indicated that nitrogen is the most important nutrient limiting growth in these lakes. Nitrate additions produced responses similar to those of ammonia treatments. Phosphorus added alone had no appreciable effect, but when it was added with nitrogen, chlorophyll a concentrations increased markedly. Results of 12 bioassays indicated that nitrogen most frequently limited chlorophyll a production, but that occasionally other nutrients were limiting. In the Great Salt Lake, acetylene reduction was stimulated significantly only by P additions. In East Canyon Reservoir, the effects of nutrients on N fixation were complex, with P, iron, and molybdenum additions stimulating nitrogenase activity. It is concluded that phosphorus, iron, and molybdenum limitation may all be important in restricting nitrogen fixation in some lakes of the Great Salt Lake Basin thus important for maintaining N deficiency in these systems. (Doria-PTT)
W89-04489

RELATION OF HYDROGEOLOGIC SETTING TO CHEMICAL CHARACTERISTICS OF SELECTED LAKES AND WETLANDS WITHIN A CLIMATE GRADIENT IN THE NORTH-CENTRAL UNITED STATES,
Geological Survey, Lakewood, CO. Water Resources Div.
J. W. LaBaugh.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 131-137, January 1988. 2 fig, 1 tab, 16 ref.

Descriptors: *Limnology, *Surface-groundwater relations, *Geohydrology, *Lakes, *Wetlands, *Groundwater, Bicarbonates, Calcium, Sulfates, Specific conductivity, Sodium, Seasonal variation, Spatial distribution, Annual distribution, Climatology, Dolomite, Calcite, Minerals, Groundwater movement, Physical properties, Chemical properties.

The chemical characteristics of lakes or wetland and groundwater at each of three sites is summarized and related to the hydrogeologic setting. The three sites are Crescent Lake National Wildlife Refuge, NE, Cottonwood Lake area, ND, and Williams Lake, MN. The relative composition of major ions in the surface waters of each site reflects the interaction of those surface waters with adjacent groundwater flow systems. For example, the presence of sodium bicarbonate waters in the Crescent Lake National Wildlife Refuge is consistent with the interaction of groundwater with the dune sand the lakes are located in. Comparison of specific conductance of the water in lakes and wetlands indicates the trend of increased concentration with increased aridity reported previously cannot be assumed to be more than a general trend. Results also indicate that lakes or wetlands that are located in the same area cannot be assumed to respond identically to seasonal and annual changes in climate. Instead, each lake or wetland responds differently based on its interaction with groundwater. Also, interaction with groundwater cannot be assumed from topographic position alone, since the configuration of water table was not always a replica of the land surface. (Doria-PTT)
W89-04490

USE OF REGIONAL LAKE-SULFATE CONCENTRATIONS IN THE EVALUATION OF WATERSHED PROCESSES IN HIGH-ELEVATION PARTS OF THE WESTERN UNITED STATES,
Geological Survey, Lakewood, CO.
J. T. Turk.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 138-143, January 1988. 6 fig, 3 ref.

Descriptors: *Acid rain, Limnology, *Lakes, *Sulfates, *Watersheds, Wilderness areas, *Weathering, Catchment areas, Groundwater basins, Chromatography, Distribution, Evapotranspiration, Adsorption, Chlorides, Model studies, Chemical reduction.

A conceptual model of lake chloride and sulfate is used to determine the relative importance of evapotranspiration, adsorption, reduction, dryfall, and weathering in watersheds of lakes in wilderness areas. The frequency distributions of chloride and sulfate in two wilderness areas in Colorado were found to be consistent with the conceptual model. As predicted, data indicate that evapotranspiration and dryfall are not significant processes that influence the concentration of sulfate in lakes compared to wetfall in most of the lake watersheds. Sulfate-removal processes, such as ion adsorption and reduction, may be important in several watersheds. Weathering of sulfur minerals is important in many watersheds of the more mineralized area. (Author's abstract)
W89-04491

CHARACTERISTICS OF LAKES IN MOUNTAINOUS AREAS OF THE WESTERN UNITED STATES,
Northrop Services, Inc., Corvallis, OR.
J. M. Eilers, D. F. Brakke, D. H. Landers, and P. E. Kellar.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 144-151, January 1988. 2 fig, 4 tab, 12 ref.

Descriptors: *Limnology, *Lakes, *Mountain lakes, *Chemical properties, *Surveys, *Acid rain, Acidity, Calcium, Sulfates, Organic carbon, Conductance, Physical properties, Cations, California.

The U.S. Environmental Protection Agency initiated the National Lake Survey to quantify the number, location, and characteristics of lakes in the United States with little or no acid neutralizing capacity (ANC). Results of the survey of 10,393 western lakes sampled in 1985 are presented. There was a high proportion of low ANC lakes in the west, although only one acidic lake was sampled. California had the highest percentage (36.7%) of low ANC lakes. Calcium, sulfate, and dissolved organic carbon concentrations were generally low throughout the west, and particularly in California. More than 26% of western lakes had conductance < 10 microS/cm; most of these were located in California. It is concluded that a high proportion of western lakes are extremely dilute, have low ANC, and low base cation concentrations. However, virtually no acidic lakes were found in the west, and the current deposition is relatively low in acidity. The autumn lake chemistry provides no evidence of chronic acidification in these lakes. However, the potential importance of short-term, acute acidification cannot be assessed using these data. (See also W89-04493) (Doria-PTT)
W89-04492

CHARACTERISTICS OF ACIDIC LAKES IN THE EASTERN UNITED STATES,
State Univ. of New York Coll. at Oswego.
D. H. Landers, J. M. Eilers, D. F. Brakke, and P. E. Kellar.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 152-162, January 1988. 6 fig, 1 tab, 17 ref.

Descriptors: *Limnology, *Acid rain, *Lakes, *Chemical properties, Rainfall, Acidity, Sulfates, Anions, Ions, Large watersheds, Small watersheds, Lake Morphometry, Elevation.

The National Lake Survey, implemented by the U.S. Environmental Protection Agency in 1984, was a one-time fall sampling of lakes in regions of the United States susceptible to acidic deposition. Results of the Eastern Lake Survey are described; these results support the following conclusions: (1) Acidic lakes generally have smaller surface areas than non-acidic lakes; (2) In the Northeast, acidic lakes tend to be at higher elevations than non-acidic systems; (3) Lakes with small watershed area to lake area ratios (i.e., shorter watershed contact time) tend to be more acidic than those systems with larger ratios, indicating the importance of watershed processes in determining Acid-neutralizing capability; (4) Sulfate, rather than organic anion, is the dominant anion in most acidic lakes of the Northeast and Florida, but less so in the Upper Midwest. These findings support the hypothesis that sulfate and not organics is responsible for the acidic condition of most acidic lakes in the Northeast, Florida, and the Upper Midwest; and (5) High sulfate concentrations are not a characteristic of acidic lakes, alone. Sulfate concentrations are similar in populations of acidic and non-acidic lakes in the Northeast and Upper Midwest. Non-acidic Florida lakes have elevated sulfate concentrations, probably from watershed sources. (See also W89-04492) (Author's abstract)
W89-04493

HAS SILICA INCREASED IN LAKE SUPERIOR WATERS,
Florida Univ., Gainesville. Dept. of Fisheries and

Aquaculture.
For primary bibliographic entry see Field 5C.
W89-04494

VERY IMBALANCED NUTRIENT BUDGET FOR MIRROR LAKE, NEW HAMPSHIRE, U.S.A.,
Institute of Ecosystem Studies, Millbrook, NY.
N. F. Caraco, J. J. Cole, G. E. Likens, M. D. Mattson, and S. Nolan.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 170-175, January 1988. 1 fig, 1 tab, 23 ref.

Descriptors: *New Hampshire, *Limnology, *Cycling nutrients, *Mirror Lake, *Lakes, Nutrients, Euphotic zone, Oligotrophic lakes, Stratification, Epilimnion, Precipitation, Runoff, Nitrogen fixation, Seepage, Nitrogen, Phosphorus, Sediments.

Ongoing efforts to construct a balanced nutrient budget for the epilimnion of oligotrophic Mirror Lake, New Hampshire are discussed. Data thus far indicate that there is a gross imbalance in the P and N budgets. During summer stratification, measured outputs exceed inputs more than 50-fold for P and 4-fold for N. These discrepancies could be due to an overestimate in measured outputs of particles or to the fact that groundwater seepage inputs or epilimnetic regeneration, are extremely large. These three fluxes are now being measured. Continual measurements are also being made of bulk precipitation, runoff, and outflow. However, calculations are presented that demonstrate that the Mirror Lake epilimnetic nutrient budget is likely to remain imbalanced even after careful re-assessment of these inputs and outputs. In other parts of the world, insects have been reported as important nitrogen or phosphorus sources for lakes. The possible existence of unusual nutrient sources is being investigated. (Author's abstract)
W89-04495

SEASONAL DYNAMICS OF PHYSICAL AND CHEMICAL PROPERTIES OF A WARM MONOMICTIC RESERVOIR,
Georgia Univ., Sapelo Island. Marine Inst.
J. J. Alberts, J. W. Bowling, J. E. Schindler, and D. E. Kyle.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 176-180, January 1988. 2 fig, 1 tab, 10 ref. DOE OHER contract EY-76-C-09-0819.

Descriptors: *Limnology, *Dynamics, *Reservoirs, *Mixing, Seasonal variation, Iron, Manganese, Calcium, Chemical properties, Physical properties, Potassium, Heavy metals, Temperature, Dissolved oxygen, Conductivity, Hydrogen ion concentration, Thermal stratification,mocline, Profiles, Organic carbon, Hypolimnion, South Carolina.

The annual cycle of physicochemical parameters in a monomictic reservoir in South Carolina is discussed, based on the results of monthly monitoring undertaken during 1983-84. Thermal stratification of the water column was evident by mid-April, and an intense stratification was established from May through September. Fall overturn of the water column occurred rapidly in late October, followed by a period of holomixis which extended from November through February. The pH and conductivity of bottom waters increased during the period of anoxia in the summer. Significant increases of elemental and dissolved organic carbon concentrations occurred in the hypolimnion in October. Calculated inventories of iron, manganese, potassium, calcium, and dissolved organic carbon in the reservoir showed percentage losses ranging from 45.6% to 100% between October 1983 and February 1984. Very rapid mixing occurred during a 2- to 3-week period in October-November 1983, possibly facilitating the co-precipitation with iron and manganese hydroxides of the calculated quantities of calcium, potassium, and carbon. (Doria-PTT)
W89-04496

EXAMPLES OF CHANGES IN WATER CHEMISTRY DURING LAKE ACIDI- AND 'DEACIDIFICATION',
Uppsala Univ. (Sweden). Limnologiska Institutionen.
C. Forsberg, and G. Morling.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 193-199, January 1988. 2 fig, 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Acid rain, *Lakes, *Acidification, *Sulfates, Sweden, Alkalinity, Bicarbonates, Chemical composition, Chemical properties, Hysteresis, Cations, Anions, Ions, Calcium, Magnesium, Sodium, Potassium, Chloride, Nitrates, Hydrogen.

Rates of change in water chemistry and the role of sulfate during acidification and deacidification are discussed for two lakes in western Sweden, based on long-term analysis. Between 1967 and 1977, sulfate concentrations increased almost linearly from 100 to 300 microeq/l. The alkalinity reserve was lost in Lake Oxsjon in 1971, while Lake Anketjarn still has small, but declining, amounts of bicarbonate. Increasing sulfate concentrations reduced pH in Lake Oxsjon from 6.8 to 4.5, while decreasing concentrations improved pH by only 0.2 units. During acidification and deacidification, sulfate concentration increased and decreased by 20 and 12 microeq/l/yr, respectively. Calcium concentration in Lake Anketjarn increased during deacidification by 6 microeq/l/yr. Ca, Mg, and K decreased in Lake Oxsjon, but increased in Lake Anketjarn. Principal differences between acidification and deacidification stages are demonstrated by different degree of couplings between sulfate and hydrogen ion, Ca and Mg. Hysteresis between acidification and deacidification stages is demonstrated. It is concluded that sulfate during deacidification is losing part of its central role in steering the ionic composition of these lakes. (Author's abstract)
W89-04498

GEOCHEMICAL TRACES OF RIVERINE INFLUENCE ON A TROPICAL LATERAL LAKE,
Papua New Guinea Univ., Port Moresby. Dept. of Biology.
P. L. Osborne, N. V. C. Polunin, and K. Nicholson.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 207-211, January 1988. 3 fig, 2 ref.

Descriptors: *Path of pollutants, *Geochemistry, *Lakes, *Rivers, *Sediments, Environmental protection, Tropical regions, New Guinea, Lake sediments, Bottom sediments, Heavy metals, Zirconium, Mineralogy, Adsorption, Soil types, Peat, Clays, Zinc, Potassium, Sulfur, Organic matter, Phosphates, Sodium, Titanium, Industrial wastes, Mine wastes.

Surface sediment samples and short sediment cores were collected from Lake Daviumbu, a tributary lake adjacent to the Fly River in Papua New Guinea, in order to investigate the spatial distribution of sediments and their metal content in relation to riverine inputs and catchment area drainage. The distribution of elements in the surface sediments was found to follow a distinct pattern, with clearly defined concentration gradients between lake center and margins. Zirconium is concentrated in the center of the lake and near the main river channel, indicating a significant discharge of fluvial material into the lake. Elemental profiles with depth demonstrate the importance of mineralogical and organic controls on distribution of Na2O, K2O, Zr, and Ti. In contrast, transition metals are bound to organic matter. Some Zn not bound to organic matter may be remobilized towards the surface sediments on burial, P2O5 may be remobilized on burial with subsequent release at the sediment-water interface. It is concluded that the river, and not the surrounding land, is the dominant source of allochthonous material in Lake Daviumbu. The effects of mining upstream will therefore have an impact on these lakes. (Doria-PTT)
W89-04499

HYPOLIMNETIC AERATION RESEARCH IN BRITISH COLUMBIA,
British Columbia Ministry of Environment, Vancouver. Fisheries Research and Technical Services Section.
For primary bibliographic entry see Field 5G.
W89-04500

EFFECT OF OXYGEN DEPLETION ON THE TIMING AND MAGNITUDE OF BLUE-GREEN ALGAL BLOOMS,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-04501

COMPOSITION, DISTRIBUTION AND STANDING CROP OF THE BENTHOS IN A SHALLOW LAKE,
Toronto Univ. (Ontario). Dept. of Zoology.
W. R. Allison, and H. H. Harvey.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 241-245, January 1988. 2 fig, 3 tab, 9 ref.

Descriptors: *Limnology, *Benthos, *Lakes, *Shallow water, *Species composition, Distribution, Foods, Fish food, Fish, Perch, Biomass, Environment, Benthic environment, Sampling, Midges, Nutrients, Cycling nutrients, Temperature, Physical properties.

The many shallow lakes of Manitoulin Island and the Bruce Peninsula (Canada) support large fish populations with great inter-lake community diversity, despite periodic winter kills. In one lake subject to winter kill, the benthos was investigated as the primary food resource of the most important fish in the lake, the yellow perch. Based on biomass estimates obtained from other studies, and the patterns of benthic associations in the lake were compared to the investigator's a priori conjectures about the influence of visible environmental factors on these associations. The calculated biomass was 17.7 kg/ha, and was dominated by six major taxa (92.4% by count), of which amphipods and chironomids were the most abundant at 55% of the total count, and 8.8% of the calculated biomass. Although the combination of sampling with the corer and sorting by flotation conserves many of the smaller organisms ordinarily lost by more conventional methods, it seems probable that the benthic biomass was underestimated since a) the K-B corer cross section = 19.6 sq cu did not effectively capture the macroinvertebrates, such as crayfish and dragonfly nymphs, both of which were resent in substantial numbes and had a unit mass many times larger than that of the average organism sampled; b) onlythe commonest taxa were included in the biomass estimates; c) two samples containing very high counts of very large chironomids (1.0 cm), were excluded as outlined. It is concluded that the benthic biomass of Smoky Hollow Lake was underestimated. The discrepancy between the constancy of benthic biomass observed in this lake and the variation reported elsewhere cannot be clearly accounted for. (Doria-PTT)
W89-04503

METALS IN CHIRONOMIDAE LARVAE AND ADULTS IN RELATION TO LAKE PH AND LAKE OXYGEN DEFICIENCY,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W89-04504

DAPHNIA-HOLOPEDIUM RELATIONSHIPS IN CANADIAN SHIELD LAKES RANGING IN ACIDITY,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
N. D. Yan, W. Keller, J. R. Pitblado, and G. L. Mackie.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen

IVTLAP, Vol. 23, No. 1, p 252-257, January 1988. 1 fig, 4 tab, 12 ref.

Descriptors: *Limnology, *Population dynamics, *Waterfleas, *Daphnia, *Canadian Shield, *Lakes, *Acidity, *Acid rain effects, *Ecology, Crustaceans, Rainfall, Biomass, Zooplankton, Plankton, Aquatic life, Correlation analysis.

Holopedium gibberum, Daphnia galeata mendotae, and D. pulex are the dominant planktonic Cladocera in Canadian Shield lakes, contributing an average of 53% of the biomass of herbivorous zooplankton. Holopedium outnumbers Daphnia only when zooplanktivores are present, while the competitive fitness of Daphnia may be reduced in lakes of sufficiently low pH. Data from lakes in central Ontario were examined to investigate the hypothesis that Daphnia biomass and pH are positively correlated and to determine if Daphnia and Holopedium biomass are negatively correlated. The biomass of the two Daphnia species was found to be reduced in the more acidic lakes in each of three surveys. There was a negative relationship between the biomass of Holopedium and the dominant Daphnia species, but only in data sets where samples were collected on at least a monthly basis for more than a year. It is concluded that although patterns consistent with the competitive interplay of H. gibberum and dominant Daphnia species are not evident in synoptic surveys, such patterns are detectable in Canadian Shield lakes that are intensively monitored. (Author's abstract)
W89-04505

PHOSPHORUS-PHYTOPLANKTON RELATIONSHIPS IN NUTRIENT-POOR SOFT-WATER LAKES IN CANADA,

Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, K. H. Nicholls, B. A. Locke, E. de Grosbois, and N. D. Yan.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 258-264, January 1988. 4 tab, 14 ref.

Descriptors: *Limiting nutrients, *Limnology, *Phosphorus, *Phytoplankton, *Canada, *Lakes, *Chlorophyll a Deficient elements, Plankton, Aquatic plants, Nutrients, Mesotrophic lakes, Oligotrophic lakes, Zooplankton, Biomass, Chemical properties, Physical properties, Trophic level.

Many of the published empirical nutrient-phytoplankton relationships are based on analysis of global data sets in which variables typically span 2-4 orders of magnitude. In some regions of the world, the variability in trophic status between lakes is much less than this. To see if useful relationships exist over a much smaller trophic gradient, 16 oligotrophic and mesotrophic lakes were studied for a four-year period. The range in both total phosphorus and chlorophyll a between these lakes was only 3-fold. Nevertheless, excellent relationships between these parameters were found, with typically 80% of the variability in chlorophyll a being explained by total phosphorus. The residual variance was, in all cases, most strongly correlated to the total nitrogen:total phosphorus ratio. Substitution of phytoplankton biomass for chlorophyll a resulted in even better relationships as long as the diatom fraction was excluded from the biomass. Zooplankton biomass did not explain a significant amount of the residual variance in any case. (Author's abstract)
W89-04506

SUBMERGED MACROPHYTES AND SEDIMENT BACTERIA IN THE LITTORAL ZONE OF LAKE MEMPHREMAGOG (CANADA),

McGill Univ., Montreal (Quebec). Dept. of Biology.
C. M. Duarte, D. F. Bird, and J. Kalff.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 271-281, January 1988. 6 fig, 1 tab, 35 ref.

Descriptors: *Lake Memphremagog, *Limnology, *Canada, *Macrophytes, *Submerged plants, *Bacteria, *Physiological ecology. Sediments, Aquatic plants, Lake sediments, Zones, Littoral zone, Biomass, Decomposition, Chemical properties, Metabolism, Roots, Lakes.

The hypothesis that the abundance of sediment bacteria may be related to the biomass of submerged plants was tested by examining the relationship between sediment bacteria, submerged plants, and sediment characteristics in Lake Memphremagog, Quebec, a large mesotrophic lake whose diverse littoral zone provides a wide range of sediment types. A relatively strong relationship was found between bacterial counts and submerged macrophyte biomass, supporting the view that submerged macrophytes have an important influence on sediment characteristics, either directly through root metabolism or through the beds acting as sediment traps for planktonic organic matter. It is concluded that the effect of macrophytes does not appear to depend solely on their bulk contribution to the organic carbon of the sediments, but might be attributable to the quality of the compounds released during plant growth that appear to stimulate bacterial growth. (Doria-PTT)
W89-04507

PHYSICAL, CHEMICAL, WATERSHED AND PLANKTON CHARACTERISTICS OF LAKES ON THE AVALON PENINSULA, NEWFOUNDLAND, CANADA: A MULTIVARIATE ANALYSIS OF INTERRELATIONSHIPS,

Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
R. Knoechel, and C. E. Campbell.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 282-296, January 1988. 9 fig, 10 tab, 22 ref.

Descriptors: *Watersheds, *Limnology, *Canada, *Water chemistry, *Plankton, *Lakes, *Newfoundland, Catchment areas, Groundwater basins, Multivariate analysis, Flushing, Drainage area, Temperature, Water temperature, Precipitation, Evapotranspiration, Wind, Mixing, Water use, Nitrates, Silicates, Sulfates, Calcium, Magnesium, Phosphorus, Land use, Regression analysis, Physical properties, Chemical properties.

The physical, chemical, and plankton characteristics of lakes on the Avalon Peninsula, Newfoundland are discussed. These lakes are characterized by rapid flushing resulting from high drainage area to lake volume ratios combined with a 100 cm annual excess of precipitation over evapotranspiration. Lake temperatures exceed mean air temperature throughout the summer and high winds maintain mixing throughout the water column. Water chemistry of lakes with undisturbed watersheds is similar to that of other shield lakes; residential watershed usage is reflected most notably as increased nitrate, silicate, sulfate, calcium, and magnesium. Factor analysis reduced the data to a smaller set of composite variables and interrelationships were then examined using multiple linear regression. Land use and flushing rates were the factors best correlated with variation in lake water chemistry. Plankton characteristics were strongly influenced by flushing, phosphorus, and land use. (See also W89-04509) (Author's abstract)
W89-04508

ZOOPLANKTON COMMUNITIES AND TROPHIC STRUCTURE OF LAKES ON THE AVALON PENINSULA, NEWFOUNDLAND, CANADA,

Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
C. E. Campbell, and R. Knoechel.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 297-305, January 1988. 2 fig, 2 tab, 25 ref.

Descriptors: *Zooplankton, *Trophic level, *Lakes, *Newfoundland, *Limnology, *Canada, Phytoplankton, Eutrophication, Plankton, Aquatic plants, Species composition, Predation, Biomass, Fish, Stickleback, Correlation analysis, Ecology.

The zooplankton communities of 17 oligotrophic lakes on the Avalon Peninsula of Newfoundland were examined to determine the relative influences of phytoplankton biomass (bottom-up factor) and vertebrate and invertebrate predators (top-down factors) on total zooplankton biomass, size spectra, and species composition. It was found that zooplankton community structure does not seem to be strongly influenced by bottom-up (producer or resource controlled) factors. Total zooplankton biomass showed not significant correlation with total phytoplankton biomass, and there was no shift in zooplankton size spectra or species composition towards smaller forms with increasing phytoplankton biomass. Top-down (consumer-controlled) factors do seem to influence zooplankton community structure in these lakes. Pelagic zooplankton constituted the major portion of stickleback diet, and total zooplankton biomass showed a significant negative correlation with the estimate of stickleback density. It is concluded that the zooplankton community is influenced more by top-down factors under oligotrophic conditions. Bottom-up factors may predominate only as lake productivity increases to eutrophic conditions. (See also W89-4508) (Doria-PTT)
W89-04509

SOURCES FOR INTERNAL P LOADING IN A SHALLOW LAKE,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, C. L. DeGasperi, and D. E. Spyridakis.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 307-314, January 1988. 6 fig, 16 ref.

Descriptors: *Limnology, *Washington, *Phosphorus, *Cycling nutrients, *Eutrophic lakes, *Shallow water, *Eutrophication, Nutrients, Lakes, Anaerobic conditions, Aerobic conditions, Sediments, Lake sediments, Decomposition, Biodegradation, Degradation, Oxygen, Dissolved oxygen, Acidity, Chemical reduction, Oxidation.

Long Lake, Washington is a shallow, eutrophic lake in which macrophyte senescence has not been an important, direct contributor to internal P loading. Rather, the alternation between anaerobic and aerobic conditions in surficial sediments, and water immediately overlying the sediments, is hypothesized to promote an opportunity for P release from sediments as a result of iron reduction followed by transport of the P-rich surficial sediment particles and overlying water during wind mixing. That is considered to be the principal mechanism accounting for internal P loading, which was almost completely interrupted for four years by an alum treatment. Other mechanisms, such as temperature-controlled microbial decomposition and high pH, considered important in other shallow lakes, may contribute, but the presence of low dissolved oxygen at the sediment surface and a high available inorganic P fraction point to iron redox reactions being more important in Long Lake. However, Long Lake is not considered unique in this regard, but may be representative of many soft water, shallow, macrophyte-infested, eutrophic lakes. (Author's abstract)
W89-04510

NUTRIENT SUBSIDY IN MONTANE LAKES: FLUVIAL SEDIMENTS VERSUS VOLCANIC ASH,

Montana Univ., Polson. Flathead Lake Biological Station.
B. K. Ellis, and J. A. Stanford.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 327-340, January 1988. 6 fig, 5 tab, 29 ref.

Descriptors: *Limnology, *Volcanoes, *Mountain lakes, *Cycling nutrients,vial sediments, *Model studies, *Phosphorus, Sediments, Lakes, Nutrients, Limnology, Chemical properties, Physical properties, Phytoplankton, Plankton, Aquatic plants,

Algae, Benthos, Particulate matter, Adsorption, Clays, Soil types, Bacteria, Ionization.

The relative importance of ash fall versus sediment inputs as influences on the limnology of three high-altitude lakes in glacier National Park, Washington was investigated following the eruption of nearby Mount St. Helens. Measurements of the biologically active portion of the particulate phosphorus contained in ash as compared to streambank soils and fluvial sediments demonstrated that the clay particles stimulated greater algal growth than did the ash. It is concluded that the ash fall on the surface of Upper Kintla and other lakes was sufficiently light to produce no lasting subsidy effect on lakewide productivity. Fluvial sediments did exert a fertilization effect, probably masking any basin-wide effect of the ash fall. A conceptual model of phosphorus cycling in phycospheres in phosphorus-limited lakes is proposed where the initial mobilization of P is mediated by heterotrophic bacteria attached to the surface of clay particles. Incorporation of ionic P into bacterial cells may involve a redox gradient that is actively created in the area of cell to substrate (clay) attachment. Algae in the phycosphere secondarily utilize the organic metabolites of the bacteria, which contain the P substrates they require for growth. Adsorption and ionization probably buffer the cycle, along with the N and micronutrient physiology of the microbial community and the concentration and age of the inorganic particles in the water column. This model remains to be tested in controlled experiments, but does suggest a mechanism by which productivity in Cerulean Lake is continually enhanced. (Doria-PTT)
W89-04511

EFFECTS OF RECLAMATION ON AN URBAN WINTER-KILL LAKE AT WINONA, MINNESOTA, U.S.A.,
Winona State Univ., MN. Dept. of Biology.
For primary bibliographic entry see Field 5G.
W89-04512

ROLE OF SEDIMENTATION IN REGULATING MAJOR ION COMPOSITION IN A SOFTWATER, SEEPAGE LAKE IN NORTHERN WISCONSIN,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
L. A. Baker, J. E. Tacconi, and P. L. Brezonik.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 346-350, January 1988. 1 fig, 3 tab, 10 ref.

Descriptors: *Acid rain effects, *Limnology, *Water chemistry, *Sedimentation, *Seepage, *Lakes, Chemical composition, Ions, Trace metals, Acidic water, Calcium, Magnesium, Potassium, Sulfates.

Sediment traps were used to measure sediment deposition in Little Rock Lake, a small, experimentally acidic seepage lake in northern Wisconsin. Annual lake-wide deposition was 102 g/sq m/yr and was similar in the acidified and non-acidified basins. Sedimentation removed 9-14% of the Ca, Mg, and K, and 26% of the sulfate from the water column annually; removal of these ions by sedimentation is roughly comparable with atmospheric inputs. These data indicate that sedimentation plays an important role in regulating the major ion composition of extremely dilute softwater lakes. (Author's abstract)
W89-04513

GREAT LAKES ECOSYSTEM EXPERIMENT,
Wisconsin Univ.-Madison. Sea Grant Inst.
R. A. Ragotzkie.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 359-365, January 1988. 1 fig, 2 tab, 16 ref. NOAA Grant NA84AA-D-00065.

Descriptors: *Great Lakes, *Eutrophication, *Environmental effects, *Lakes, *Water quality management, *Hydrology, Trophic level, Fish, Predation, Parasites, Flushing, Precipitation, Flow.

In the past century, the Great Lakes have been subjected to two major sets of perturbations: (1) increased nutrient loadings, followed by reductions in recent years, and (2) the introduction of non-native species of parasitic, planktivorous and predatory fish. The effects on the lakes and their ecosystems have varied from lake to lake. Examination of the hydrologic and morphometric characteristics of the lakes suggests that the different responses are due in part to their widely varying volumes and flushing rates. Recent above-normal precipitation in the basin and the consequent increased water flow through the lakes probably accentuates these differences. These hydrologic factors should be explicitly considered in the development of policies for the management of water quality and fisheries of these lakes. (Author's abstract)
W89-04514

EXCRETION OF PHOSPHATE AND AMMONIA FROM MICROCRUSTACEANS, AND ITS VERTICAL AND SEASONAL DISTRIBUTION AT AN OFFSHORE STATION IN LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. L. Busch, and A. S. Brooks.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 366-375, January 1988. 5 fig, 31 ref. NOAA Grant NA 84AA-D-0-0065.

Descriptors: *Limnology, *Phosphates, *Population dynamics, *Ammonia,staceans, *Zooplankton, *Lake Michigan, *Cycling nutrients, Plankton, Seasonal variation, Distribution, Vertical distribution, Nutrients, Algae, Physiological ecology.

A study was conducted to estimate the zooplankton contribution of phosphate and ammonia in a Lake Michigan water column, observe vertical and temporal variation in this input, and quantify the percent contribution of this nutrient source. Daily nutrient excretion rate was divided by the ambient nutrient concentration to derive a daily percentage of nutrient due to the zooplankton. This was divided by the computed nutrient excretion rate for both phosphate and ammonia. In June, with surface water warming and rapid growth of zooplankters, ammonia excretion averages 12% of total NH3 available in the metalimnion,. By midsummer, zooplankton excretion became the dominant source of epilimnetic P (100%). Moreover, the progression of dominant algal species suggests that zooplankton direct the species composition of the phytoplankton. It is concluded that zooplankton not only enhance nutrient availability at certain times of year in Lake Michigan, but also play a major role in determining the succession of algal species. (Doria-PTT)
W89-04515

IMPORTANCE OF NANNOPLANKTON ALONG THE TROPHIC GRADIENT IN GREEN BAY, LAKE MICHIGAN,
Wisconsin Univ.-Green Bay. Coll. of Environmental Sciences.
P. E. Sager, B. Rubio, and J. Kirk.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 376-379, January 1988. 3 fig, 2 tab, 11 ref.

Descriptors: *Limnology, *Green Bay, *Plankton, *Trophic level, *Lake Michigan, *Light penetration, Biomass, Eutrophic lakes, Plankton, Aquatic plants, Secchi disks, Analysis of variance, Regression analysis, Statistical analysis, Chlorophyll a, Productivity.

The trophic gradient in Green Bay, Lake Michigan is used to examine the effect of trophic conditions on nannoplankton. Size-fractionated measurements of chlorophyll a and C14-productivity samples taken along the trophic gradient indicate that for both parameters, the percent contribution of the nannoplankton to the total phytoplankton varies inversely with increasing eutrophic conditions. Analysis of variance for both total phosphorus and Secchi disk regressions indicates that both variables are significant factors relating to the importance of the nannoplankton. However, light availability is implicated as more significant than nutrient availability in predicting the relative importance of the nannoplankton, especially under eutrophic conditions along a trophic gradient. While nannoplankton may increase in absolute abundance with eutrophication, it appears that their increase is substantially less than that of the larger, net-phytoplankton species. Therefore, the proportional contribution of the nannoplankton to the total phytoplankton changes more significantly over a range of trophic conditions. (Doria-PTT)
W89-04516

DEVELOPMENT OF AN ENVIRONMENTAL SENSITIVITY INDEX FOR COASTAL AREAS OF LAKE ERIE, NORTH AMERICA,
Ohio State Univ., Columbus. Franz Theodore Stone Lab.
C. E. Herdendorf, and L. A. Fay.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 380-385, January 1988. 1 fig, 4 ref. NOAA Grant NA81AA-D-00095.

Descriptors: *Environmental protection, *Mapping, *Coastal zone management, *Classification, *Great Lakes, *Planning, *Geomorphology, Biological properties, Wildlife management, Fish management, Social aspects, Economic aspects, Shores, Sedimentology, Water pollution, Water pollution control, Protection, Wetlands.

A classification scheme for an Environmental Sensitivity Index (ESI) was developed to depict the sensitivity of the coast on U.S. Geological Survey topographic maps on which diverse resource data could be illustrated. The index incorporates geomorphological and sedimentological characteristics of the shoreline as well as biological and socioeconomic considerations. Ten sensitivity categories were established based on the sensitivity of coastal areas to oil spills and discharges of other hazardous materials. The categories ranging from least sensitive to most sensitive are: exposed bedrock bluffs < exposed unconsolidated sediment bluffs < shelving bedrock shores < mixed sand and gravel shores < gravel shores < rip-rap and other harbor structures < sheltered bluffs < low blanks < coastal wetlands. The scheme was tested by mapping the shoreline of Lake Erie and connecting waterways. Sixty-six topographic maps were prepaed for inclusion in an atlat of coastal resources for use by field personnel involved in decision-making and spill clean-up operations. The Lake Erie ESI is designed as a pilot program before the other Great Lakes. (Doria-PTT)
W89-04517

LITTORAL VS PROFUNDAL COMPONENTS OF SEDIMENT ACCUMULATION: CONTRASTING ROLES AS PHOSPHORUS SINKS,
Academy of Natural Sciences of Philadelphia, PA.
R. E. Moeller, and R. G. Wetzel.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 386-393, January 1988. 4 fig, 1 tab, 27 ref. NSF Grants DEB77-16638; BSR 80 01190; DOE Grants DEO2-FG/87ER60515; COO-1599-302.

Descriptors: *Paleolimnology, *Limnology, *Littoral zone, *Sedimentation, *Phosphorus, *Cycling nutrients, *Lakes, Zones, Nutrients, Glacial lakes, *Palynology, Carbon, Organic carbon, Carbonates, Macrophytes, Phytoplankton, Plankton, Aquatic plants, Productivity, Algae, Limiting nutrients.

Patterns of sediment accumulation are contrasted for two small post-glacial lakes, using a mid-19th century pollen horizon as a chronological marker. In a softwater lake (Mirror Lake, NH), sediment accumulates only in the profundal zone, but in a calcareous hardwater lake (Lawrence Lake, MI), a distinct littoral deposit accounts for 25% of the sedimentary P, 38% of the organic carbon, and 51% of the carbonate C. Molar ratios of organic C:P are higher in the littoral sediment (ca. 700) than in the profundal sediment (ca. 350). The ratio

increases linearly with depth into the littoral sediment, suggesting that the littoral sediment includes a surficial store of slowly remineralized P that sustains the rooted macrovegetation. The two lakes are compared with respect to estimated P loading, and productivity of phytoplankton, periphyton, and macrophytes. The relatively high production of macrophytes in Lawrence represents an independent allocation of limiting P that has no negative effect on total algal production, but that may favor periphytic production at the cost of the phytoplankton. (Author's abstract)
W89-04518

ECOSYSTEM STUDIES OF NORTH ATLANTIC RIDGE LAKES,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
P. M. Jonasson, and C. Lindegaard.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 394-402, January 1988. 4 fig, 2 tab, 32 ref.

Descriptors: *Limnology, *Ecosystems, *Iceland, *Lakes, *Subarctic zone, *Aquatic environment, Ecology, Environment, Climatic zones, Productivity, Aquatic productivity, Phytoplankton, Plankton, Aquatic plants, Nutrients, Hydrology, Geology, Benthos, Energy, Trophic level, Fish, Ducks, Waterfowl, Birds, Food chains.

The dynamic ecology of two neo-volcanic subarctic lakes in Iceland is discussed: the shallow Lake Myvatn and the deep Lake Thingvallavatn. Lake Myvatn is extremely productive in both phyto- and zoobenthos. Lake Thingvallavatn has no primary production and low secondary production in the profundal, but a reasonably high primary and secondary production in the littoral. The third trophic level production (fish and ducks) is about the same. Despite the low efficiency from second to third trophic level, both lakes yield a large catch of fish and have a large stock of ducks. Shallow Lake Myvatn is a unique bird lake with 15 species of ducks feeding on phytobenthos, zoobenthos, and zooplankton. In deep Lake Thingvallavatn, the food web is different, the top carnivores being fish. The main energy flow in Myvatn is channeled through phytobenthos, which accounts for 85% of total net primary production. Pelagic production is dominant in Lake Thingvallavatn. It is concluded that, in spite of long ice cover in the subarctic, shallow as well as deep neo-volcanic, nutrient-rich lakes maintain high productivity. (Doria-PTT)
W89-04519

RECENT HUMAN INFLUENCES ON THE ECOLOGY OF LOCH LOMOND, SCOTLAND,
Paisley Coll. of Tech. (Scotland). Dept. of Biology.
For primary bibliographic entry see Field 4C.
W89-04520

APPROACHES TO THE RESTORATION OF SHALLOW EUTROPHICATED LAKES IN ENGLAND,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5G.
W89-04521

GONYOSTOMUM SEMEN-A NEW NUISANCE TO BATHERS IN NORWEGIAN LAKES,
National Inst. of Public Health, Oslo (Norway).
For primary bibliographic entry see Field 5C.
W89-04522

RECENT SEDIMENTS IN THE IRON-MEROMICTIC LAKE SKJENNUNGEN,
Oslo Univ. (Norway). Dept. of Limnology.
J. Kjensmo.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 435-439, January 1988. 3 fig, 19 ref.

Descriptors: *Limnology, *Lake sediments, *Meromictic lakes, *Lake Skjennungen, *Iron, *Chemical composition, Nitrogen, Lakes, Sediments, Carbon, Nitrogen, Sedimentology, Chlorophyll, Silica, Diatoms, Sulfides, Monimolimnion, Precipitation, Manganese, Chemical reduction, Aerobic conditions, Anaerobic conditions, Heavy metals.

Lake Skjennungen, near Oslo, Norway, is an iron-meromictic softwater lake. Changes of the uppermost part of the sediments occurring when passing from the mixo- to the monimolimnetic sediments in the lake might be useful for interpreting the time for onset of meromixis. Therefore, the composition of the uppermost 5 cm of the sediments was investigated from 6 small cores taken along a transection from a water depth of 1.5-17 m. The carbon/nitrogen ratio was found to increase in sediments deeper than 8.5 m. Chlorophyll derivatives show an increase of about 20 arbitrary units with depth between 5 m and 8.5 m. Alkali-soluble silica shows interesting variations when passing from shallow-top deep-water sediments. The regional distribution of amorphous silica in the uppermost 5 cm of the sediments proves the significance of diatom frustules as the main contributor to the total content of amorphous silica in the sediments. The iron/manganese ratio of the monimolimnetic sediments reflects the anoxic environment of the deep waters, an anoxic environment characterized by sulfate reduction and precipitation of iron sulfide. (Doria-PTT)
W89-04523

ANNUAL CARBON FLUXES BETWEEN PHYTO-, ZOO-, AND BACTERIO-PLANKTON IN EUTROPHIC, LAKE FREDERIKSBORG SLOTSSO, DENMARK,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W89-04524

MAJOR PATHWAYS INVOLVED IN THE UTILIZATION OF PRIMARY PRODUCTION IN A TEMPERATE EUTROPHIC LAKE,
Carbon 14 Centralen, The International Agency for C14 Determination, 15, Agern Alle, DK-2970 Horsholm, Denmark.
L. M. Jensen, and S. Schwaerter.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 445-450, January 1988. 1 fig, 41 ref. The Danish Natural Science Research Council J.nr. 11-1816, 81-5549.

Descriptors: *Limnology, *Primary productivity, *Eutrophic lakes, *Carbon cycle, *Phytoplankton, Productivity, Lakes, Denmark, Carbon, Organic carbon, Carbon radioisotopes, Bacteria, Growth, Zooplankton, Plankton, Aquatic plants, Predation, Flagellates, Respiration.

The major pathways of the pelagic carbon cycling were investigated in the small eutrophic Lake Frederiksborg Slotsso, Denmark. Though phytoplankton net release of extracellular organic carbon (EOC) constituted less than 10% of phytoplankton C14-fixation, the released products still represented the most important single source of carbon substrates for bacterial growth (40%). Zooplankton grazing of phytoplankton and bacteria equaled 20% of the daily C14-fixation and bacterial net production. Calculation of bacterial losses showed that heterotrophic nanoflagellates were by far the most important bacterial predators and that the flagellates consumed about 80% of net bacterial secondary production during the period of the investigation. Overall bacterial carbon assimilation efficiency was low (30%) and bacterial respiration contributed by half of the community respiration, while that of the herbivores contributed 20%. Thus, more than two thirds of the primary production utilization was channeled through the bacterioplankton. It is suggested that bacteria are responsible for most of the mineral regeneration in the pelagial. (Author's abstract)
W89-04525

RELATIONS BETWEEN CHEMISTRY, MICROBIAL BIOMASS AND ACTIVITY IN SEDIMENTS OF A SEWAGE-POLLUTED VS A NONPOLLUTED EUTROPHIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-04526

PERIPHYTIC DIATOMS AS INDICATORS OF LAKE ACIDITY,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-04527

DOSE-EFFECT RELATIONSHIPS BETWEEN PHOSPHORUS CONCENTRATION AND PHYTOPLANKTON BIOMASS IN THE REEUWIJK LAKES (THE NETHERLANDS),
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
J. C. van der Vlugt, and S. P. Klapwijk.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 482-488, January 1988. 5 fig, 1 tab, 13 ref.

Descriptors: *Lake restoration, *Limnology, *Water quality, *Phytoplankton, *Biomass, *Physiological ecology, *Phosphorus, *The Netherlands, Nutrients, Regression analysis, Chlorophyll, Seasonal variation, Lake restoration.

Basic information on the water quality in the Reeuwijk Lakes (The Netherlands) was collected and compared with changes likely to occur when the external phosphorus load is reduced. A considerable amount of P was found in both lakes. Chlorophyll concentrations were inversely coupled with P concentrations. The chlorophyll/phosphorus ratio in Lake Nieuwenbroek is 1.4, whereas the ratio in Lake Elfhoeven is 0.6. From the regression analysis of ash-free dry weight against chlorophyll and from the seasonal fluctuations in the carbon/chlorophyll ratio, it is concluded that the difference in phytoplankton biomass between the two lakes is even greater than based on the chlorophyll concentrations alone. Therefore, the inverse relationship between phytoplankton biomass and P concentration in the two lakes is greater than stated before. It is suggested that restoring the ecosystems after 40 years of P overload may require more than lowering of the P load. (Doria-PTT)
W89-04528

ECOLOGICAL INVESTIGATIONS IN THREE SHALLOW LAKES OF DIFFERENT TROPHIC LEVEL IN THE NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands). Lab. of Hydrobiology.
R. M. M. Roijackers, and P. J. T. Verstraelen.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 489-495, January 1988. 5 fig, 2 tab, 4 ref.

Descriptors: *Limnology, *Shallow water, *Lakes, *Trophic level, *Eutrophication, *Water quality management, *The Netherlands, Lake restoration, Physical properties, Chemical properties, Biological properties, Sediments, Algae, Aquatic plants, Phytoplankton, Plankton, Nutrients, Limiting nutrients, Ecology.

Information is presented on the structure of the phytoplankton and macrophyte communities, the nutrient relationships between water, phytoplankton, and sediments, and management alternatives for the 'Vecht lakes' in the central Netherlands. The water level of these shallow lakes is maintained by inflow from neighboring polders and the River Vecht. The lakes used to be mesotrophic, but are becoming increasingly eutrophic. The most eutrophic lake is Lake Kortenhoef, followed by Lake Hollands Ankeveen and Lake Stichts Ankeveen. This sequence does not seem to agree with the demonstrated influence of Vecht water, but can be explained by the indirect supply of Lake Stichts Ankeveen via a sand pit, which acts as a natural sink for nutrients. Since the cause of eutrophication is the addition of non-Vecht water and wastewater discharges, water management is

directed towards diversion and treatment of the wastewater discharges and replacement of the present supply source. Results also emphasize the importance of sediment-borne eutrophication. Possible alternatives for replacement of the Vecht water include seepage from the Horstermeerpolder, water from the IJmeer, a large lake north of the Vecht-lakes, or a combination of both. (Doria-PTT)
W89-04529

PHOSPHORUS METABOLISM AND EUTROPHICATION CONTROL OF LAKE BALATON,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5G.
W89-04530

RECOVERY OF AN INDUSTRIALLY ACIDIFIED, AMMONIUM AND HEAVY METALS POLLUTED LAKE (LAKE ORTA, N. ITALY), DUE TO THE ADOPTION OF TREATMENT PLANTS,
Istituto Italiano di Idrobiologia, Novara.
For primary bibliographic entry see Field 5G.
W89-04531

ZOOPLANKTON STRUCTURE IN AN OLIGOTROPHIC MOUNTAIN LAKE IN NORTHERN ITALY,
Parma Univ. (Italy). Ist. di Ecologia.
R. Antonietti, I. Ferrari, G. Rossetti, L. Tarozzi, and P. Viaroli.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 545-552, January 1988. 3 fig, 3 tab, 23 ref.

Descriptors: *Limnology, *Italy, *Species composition, *Zooplankton, *Mountain lakes, *Oligotrophic lakes, Population dynamics, Ecology, Plankton, Lakes, Italy, Physical properties, Chemical properties, Seasonal variation, Predation, Biomass.

Research was carried out during the open water season at Lago Scuro Parmense, an oligotrophic lake in the Northern Apennines (Italy). Attention is focused on the following subjects: physical-chemical features of the water with particular reference of trophic state parameters; composition and seasonal succession of the zooplankton; dynamics of the dominant populations; and interactions between the species likely to be of prime importance in community structuring. It is concluded that all three zooplankton trophic compartments (macrofilter feeders, microfilter feeders, predators) are fairly represented in Lago Scuro Parmense. The absence of vertebrate predation (the lake is fishless) probably favors the growth of macrofilter feeders and enhances some characteristics (e.g., the low phytoplankton biomass) typical of oligotrophic lakes. Factors controlling structure and seasonal succession of the community can be studied by further analysis of the interactions between species. By emphasizing the role of competition between filter feeders, invertebrate predation and parasitism, the preliminary results of the research would indicate that this is a promising approach. (Author's abstract)
W89-04532

EUTROPHICATION OF LAKES AND RESERVOIRS IN ITALY,
Istituto di Ricerca sulle Acque, Brugherio (Italy).
For primary bibliographic entry see Field 5G.
W89-04533

PRE- AND POSTMONSOON LIMNOLOGICAL CHARACTERISTICS OF LAKES IN THE POKHARA AND KATHMANDU VALLEYS, NEPAL,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
K. Lohman, J. R. Jones, M. F. Knowlton, D. B. Swar, and M. A. Pamperi.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 558-565, January 1988. 3 fig, 3 tab, 23 ref. NSF Grant INT-8407884.

Descriptors: *Monsoons, *Limnology, *Lakes, *Nepal, Wind, Salinity, Ions, Cations, Phosphorus, Nitrogen, Chlorophyll A, Photosynthesis, Chemical properties, Biological properties, Stratification.

Three lakes in the Pokhara Valley of Nepal (Phewa Tal, Begnas Tal, and Rupa Tal) and two smaller ponds in the Kathmandu Valley (Tau Daha and Nag Daha) were sampled in spring and fall 1985 to determine the influence of the monsoon on their limnological conditions. Spring samples represent conditions at the end of the dry period (October to May), and fall samples were taken at the end of monsoon rains (June to September). Two changes marked postmonsoon salinity in the Pokhara Valley lakes: a 34% to 46% decrease in total salinity and a change in cationic proportions. Ionic proportions in the Kathmandu Valley ponds did not change in postmonsoon samples, but dilution was evident. Total phosphorus decreased in the Pokhara Valley lakes, but total nitrogen concentrations were generally similar to those measured before the monsoon. Both total phosphorus and total nitrogen were higher in postmonsoon samples in Nag Daha, whereas total phosphorus was half and total nitrogen similar to premonsoon samples from Tau Daha. The vertical distribution of chlorophyll a in Phewa Tal featured a narrow metalimnetic maximum approaching 100 micrograms/L at 7 m in contrast to epilimnetic values of less than 5 micrograms/L. Data suggest that the metalimnetic chlorophyll layer is an active zone of photosynthesis. The premonsoon profile indicates that such a layer may begin to develop in spring and persist until the lake destratifies. (Doria-PTT)
W89-04534

SEDIMENTATION MECHANISM OF FINE MATERIALS IN LAKE BIWA,
Geological Survey of Japan, Yatabe. Marine Geology Dept.
For primary bibliographic entry see Field 2J.
W89-04535

INFLUENCE OF RECREATION, MAINLY POWER BOATING, ON THE ECOLOGY OF THE THIRLMERE LAKES, N.S.W., AUSTRALIA,
Macquarie Univ., North Ryde (Australia). School of Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-04536

LIMITATION TO THE USEFULNESS OF CHLOROPHYLL AS A BIOMASS INDICATOR IN EUTROPHICATION STUDIES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 7B.
W89-04538

ALGAL RESPONSES TO NITROGEN AND PHOSPHORUS ADDITIONS IN FOUR CENTRAL NORTH ISLAND, NEW ZEALAND LAKEWATERS,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
G. W. Payne, E. White, S. E. Pickmere, and P. H. Woods.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 602-606, January 1988. 4 fig, 2 tab, 3 ref.

Descriptors: *Limnology, *Eutrophication, *Algae, *Nitrogen, *Phosphorus, *Lakes, *Limiting nutrients, Bioassay, Assay, Chlorophyll A, Biomass, Growth, Phytoplankton, Plankton, Aquatic plants, Ammonium, Accumulation.

The results from Lake Okataina, Rotoiti (summer), and Tarawera indicate that shortage of nitrogen restricts algal biomass there. The results from Lake Waikaremoana usefully demonstrate that chlorophyll a production can be promoted by phosphorus addition in a 4 d bioassay where that element is in short supply. Phosphorus shortage restricts biomass in this lake. Ammonium enhancement may indicate shortage of ammonia to phytoplankton communities but can occur in an abundance of nutrient nitrogen. Ammonia concentrations themselves are difficult to interpret because of interference in the analysis by dissolved organic nitrogen. Interpretation of ammonium concentrations is best restricted to identifying those high ambient concentrations where nitrogen shortage cannot restrict biomass. Luxury phosphorus uptake often occurs without any algal response by way of chlorophyll a production. Such uptake of phosphorus is often spectacular but can frequently be associated with storage by algae rather than indicate a shortage of phosphorus that is restricting algal biomass. (Author's abstract)
W89-04539

PHOSPHORUS REDUCTION REQUIRED TO CONTROL EUTROPHICATION AT LAKE ROTORUA, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 5G.
W89-04540

WATER APPEARANCE AND RECREATIONAL USE OF 10 LAKES OF THE NORTH ISLAND (NEW ZEALAND),
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
W. N. Vant, and R. J. Davies-Colley.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 611-615, January 1988. 1 fig, 2 tab, 20 ref.

Descriptors: *Lakes, *Recreation, *Optical properties, *Water use, *New Zealand, *Water quality, *Water quality management, Color, Turbidity, Physical properties, Reflectance, Limnology, Secchi disks, Swimming, Fishing, Camping, Boating, Hunting.

Water-based recreation is of major importance in New Zealand; the important components of water appearance in this regard are reflectivity, color, turbidity, and contrast attenuation. Optical properties were measured in 10 well visited and limnologically diverse lakes with records of the intensity of recreational use of these lakes to determine whether intensity of use correlate with water appearance, and, if so, in what way. Information was obtained on the following recreational uses: swimming, fishing, relaxation and observation, picnics and camping, sailing, small boats, rowing, power boating/water skiing, and recreational hunting. The following uses were considered to be most likely to be affected by water appearance: swimming, fishing, passive recreation, sailing, and power boating. It was found that swimming was the only recreational use which was sensitive to poor water appearance. The intensity of other uses was broadly similar in lakes of both good and poor appearance. It is concluded that water appearance may affect the quality of the recreational experience more than its intensity. (Doria-PTT)
W89-04541

COMPARISON OF NORTH ISLAND AND SOUTH ISLAND LAKES IN NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
V. M. Stout.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 620-623, January 1988. 12 ref.

Descriptors: *Water chemistry, *Lakes, *Geology, *Limnology, *New Zealand, Physical properties, Chemical properties, Biological properties, Geography, Rocks, Stratification, Thermal stratification, Depletion, Oxygen depletion, Light penetration, Land use, Trophic level, Plankton, Macrophytes, Benthos, Fish.

The lakes of the North and South Islands of New Zealand were compared. The two islands have pronounced contrasts in their geology and geomorphology, with related differences in the manner in which the lakes were formed and in the characteristics of the surrounding catchment areas. The North Island is hilly, but with fewer mountainous areas than in the South Island, which is mostly mountainous except for the Canterbury Plains. The winds, which are dominantly from the west, are particularly strong in the mountain valleys of the South Island. Considerably more lakes have been formed in the South Island. Differences discussed in detail include temperature stratification (stronger in the North), severe oxygen depletion in the bottom waters (more frequent in the North), light penetration (similar in both islands), water chemistry (related to rock type and land usage), phytoplankton and zooplankton species differences (especially striking for zooplankton), aquatic macrophyte distribution (similar in both islands), and the distribution of native and introduced freshwater fish. (Doria-PTT)
W89-04542

EFFECTS OF WIND ON NITROGEN, PHOSPHORUS, AND CHLOROPHYLL IN A SHALLOW NEW ZEALAND LAKE,
Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-04543

2I. Water In Plants

POSTULATED WATER AVAILABILITY GRADIENT IN A COASTAL LANDSCAPE: AN ECOPHYSIOLOGICAL ANALYSIS,
New South Wales Univ., Kensington (Australia). School of Botany.
For primary bibliographic entry see Field 2H.
W89-03391

CROP WATER USE AND WATER CONSERVATION BENEFITS FROM WINDBREAKS,
Soil Conservation Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W89-03414

EFFECTS OF SHELTER ON PLANT WATER USE,
Nebraska Univ.-Lincoln. Dept. of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 3F.
W89-03415

PLANTING DATE, ROW SPACING, AND IRRIGATION EFFECTS ON SOYBEAN GROWN ON CLAY SOIL,
Agricultural Research Service, Stoneville, MS. Soybean Production Research Unit.
For primary bibliographic entry see Field 3F.
W89-03416

SEASONAL AND SOIL FERTILITY EFFECTS ON THE RESPONSE OF WATERLOGGED COTTON TO FOLIAR-APPLIED NITROGEN FERTILIZER,
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
For primary bibliographic entry see Field 3F.
W89-03417

SIMULATION OF CROP-IRRIGATION SYSTEMS,
Bangladesh Agricultural Univ., Mymensingh. Dept. of Farm Power and Machinery.
For primary bibliographic entry see Field 3F.
W89-03427

HUMMOCKING BY LOTIC CHARA: OBSERVATIONS ON ALTERATIONS OF HYPORHEIC TEMPERATURE PATTERNS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2E.
W89-03466

EFFECTS OF WATER ACIDIFICATION ON THE DECOMPOSITION OF JUNCUS BULBOSUS L.,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W89-03467

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART I. THE DENITRIFICATION PROCESS,
Parma Univ. (Italy). Ist. di Ecologia.
F. Minzoni, C. Bonetto, and H. L. Golterman.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 189-202, March 15, 1988. 9 tab, 24 ref.

Descriptors: *Soil-water-plant relationships, *Nitrogen cycle, *Sediments, *Fertilizers, *Rice, *Denitrification, Shallow water, Temperature effects, Aquatic productivity, Quantitative analysis, Isotope studies, Fertilization, Water pollution sources, Nitrogen, Nitrates, Nitrites, Organic matter, Regression analysis, Environmental protection.

High temperatures and high production of organic matter cause important denitrification losses of nitrogen fertilizer in rice fields. Two techniques were used to quantify these losses--a N-15 technique, which can be used to quantify the amount of nitrogen finally incorporated, and an acetylene-inhibition technique, which is a direct measure of the quantities lost. In all experiments where nitrate was added it disappeared rapidly; usually about 30-50% of the nitrate that disappeared was recovered as N2O. Since the N2O itself decreased at the rather constant rate of 20% per day, a correction can be made for this N2O decrease. Using this correction, mathematical analysis indicated that as much as 80% of the fertilizer N is actually lost. This figure is in full agreement with the N15 experiments--if the N15 was applied early, only about 7% was recovered in soil and plants, while if applied later (after 7 weeks), about 20% was incorporated. Denitrification rate could be fitted on a negative exponential regression line. The rate constant increased during the summer; it is suggested that organic matter caused this increase. During denitrification considerable quantities of nitrite appear; these later disappear again by processes still unknown. The nature of the available organic matter may be important for this nitrite production. These results suggest that the efficiency of N application may be considerably increased by using low doses of N fertilizer, applied late in the growing season; this favors environmental protection as well. (See W89-03562 thru W89-03563) (Author's abstract)
W89-03561

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART II. FRACTIONATION AND BIO-AVAILABILITY OF ORGANIC NITROGEN COMPOUNDS,
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
C. Bonetto, F. Minzoni, and H. L. Golterman.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 203-210, March 15, 1988. 1 fig, 6 tab, 11 ref.

Descriptors: *Soil-water-plant relationships, *Nitrogen cycle, *Sediments, *Fertilizers, *Rice, *Nitrogen compounds, Soil chemistry, Chemical analysis, Nitrogen, Ammonia, Nitrates, Organic matter, Plant growth, Absorption, Field tests, Culturing techniques, Denitrification, Oxidation, Water pollution sources.

As the organic-nitrogen pool in soils is very large compared to the yearly N uptake by rice, direct evidence of the pool's importance is difficult to establish. A study was conducted to distinguish different N fractions with supposedly different availability. No satisfactory fractionation scheme was attained; using an alkaline, followed by an acid, extraction, the residue after the acid extraction still contained an important portion of the total N. The three fractions (alkaline and acid extracts and the residue) were analyzed for N both in pot cultures and in an experimental field with various N-application schemes, before and after rice growth. In the field experiments, the alkaline-extractable fraction nearly always increased during rice growth, except in the last growth period. The acid-extractable fraction decreased in all tests, sometimes a little, sometimes considerably. The residual fraction usually showed a decrease except in a dry period in the field, when there was a marked increase. In the pot cultures, the alkaline-extractable N showed a small increase when ammonia was used, but decreased when nitrate was used. Although about 80% of this nitrate is denitrified, rice growth was stimulated by its application, probably because of its oxidative action on organic matter. The same effect was found with hydrogen peroxide; this compound also caused the alkaline-extractable and acid-extractable fractions to decrease in N. It is thought that nitrate exerts its favorable role on growth-related N uptake in rice mainly by its oxidative capacity. Ammonia does the same, after it is automatically oxidized to nitrate in the oxygenated water of the rice field. (See W89-03561 and W89-03563) (Author's abstract)
W89-03562

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART III. THE INFLUENCE OF N-APPLICATION ON THE YIELD OF RICE,
Station Biologique de la Tour du Valat, Arles (France).
For primary bibliographic entry see Field 5G.
W89-03563

GENERAL MODEL OF FOREST ECOSYSTEM PROCESSES FOR REGIONAL APPLICATIONS: I. HYDROLOGIC BALANCE, CANOPY GAS EXCHANGE AND PRIMARY PRODUCTION PROCESSES,
Montana Univ., Missoula. School of Forestry.
S. W. Running, and J. C. Coughlan.
Ecological Modelling ECMOOT, Vol. 42, No. 2, p 125-154, August 1988. 9 fig, 4 tab, 44 ref.

Descriptors: *Mathematical models, *Ecosystems, *Forest hydrology, *Canopy, *Respiration, Plant physiology, Evapotranspiration, Primary productivity.

An ecosystem process model is described that calculates the carbon, water and nitrogen cycles through a forest ecosystem. The model, FOREST-BGC, (BioGeochemical Cycles) treats canopy interception and evaporation, transpiration, photosynthesis, growth and maintenance respiration, carbon allocation above and below-ground, litterfall, decomposition and nitrogen mineralization. The model uses leaf area index (LAI) to quantify the forest structure important for energy and mass exchange, and this represents a key simplification for regional scale applications. FOREST-BGC requires daily incoming short-wave radiation, air temperature, dew point, and precipitation as driving variables. The model was used to simulate the annual hydrologic balance and net primary production of a hypothetical forest stand in 7 contrasting environments across North America for the year 1984. Hydrologic partitioning ranged from 14/86/0% for evaporation, transpiration and outflow, respectively, in Fairbanks, AK (annual precipitation of 313 mm) to 10/27/66% in Jacksonville FL (annual ppt of 1244 mm), and these balances changed as LAI was increased from 3 to 9 in successive simulations. Net primary production (NPP) ranged from 0.0 t C/ha/year at Tuscon AZ, to 14.1 t C ha/year at Knoxville, TN and corresponded reasonably with observed values at each site. The sensitivity of ecosystem processes to varying LAI in different climates was substantial, and underscores the utility of parameterizing this model at regional scales in the future with forest LAI measurements derived from satellite imagery. (Author's abstract)
W89-03826

CHANGES IN THE SUBMERGED MACROPHYTE VEGETATION OF LAKE ROTOITI, CENTRAL NORTH ISLAND, NEW ZEALAND,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 5C.
W89-03866

COMPARISON OF SALT MARSH HUMIC ACID WITH HUMIC-LIKE SUBSTANCES FROM THE INDIGENOUS PLANT SPECIES SPARTINA ALTERNIFLORA (LOISEL),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 2L.
W89-03937

DEVELOPMENT OF A SIMPLIFIED PLANT STOMATAL RESISTANCE MODEL AND ITS VALIDATION FOR POTENTIALLY TRANSPIRING AND WATER-STRESSED WATER HYACINTHS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso.
Atmospheric Environment ATENBP, Vol. 22, No. 8, p 1707-1713, August 1988. 5 fig, 24 ref.

Descriptors: *Stomata, *Transpiration, *Water stress, *Water hyacinth, *Model studies, Stomatal transpiration, Stress, Temperature, Vapor pressure, Leaves, Air pollution, Remote sensing.

A simple model of upper-canopy plant stomatal resistance (r sub uC) was developed which requires but four input parameters: canopy aerodynamic resistance, upper-canopy foliage temperature, and air vapor pressure deficit and temperature. The model was tested against upper-canopy sunlit leaf stomatal resistance (r sub L) measurements of both potentially and non-potentially transpiring water hyacinth plants over the upper-canopy- intercepted net radiation range of 300-450 W/sq m and over a 10-fold range of r sub L. In all instances, and indicative of the model's good performance, the ratio of r sub uC/r sub L consistently averaged about 1.25, due to partial self-shading of the upper-canopy foliage. The significance of this finding to air pollution studies arises from the facts that (1) contemporary knowledge of a plant canopy's leaf area index would allow the transformation of r sub uC to r sub C, the total canopy diffusive resistance, and (2) the proper accounting for different trace gas diffusivities would allow the transformation of r sub C for water vapor to the variety of r sub C values required to infer the gaseous deposition of important pollutant gas species at vegetated surfaces. (Author's abstract)
W89-03995

FIELD EVALUATION OF AN ACID RAIN-DROUGHT STRESS INTERACTION,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 5C.
W89-04010

SIMPLE DATED WATER-PRODUCTION FUNCTION FOR USE IN IRRIGATED AGRICULTURE,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
For primary bibliographic entry see Field 3F.
W89-04206

OPTIMUM SORGHUM PLANTING DATES IN WESTERN SUDAN BY SIMULATED WATER BUDGETS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W89-04207

RAINFALL IRREGULARITY AND SOWING STRATEGIES IN SOUTHERN MOZAMBIQUE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. M. Schouwenaars.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 49-64, April 1988. 3 fig, 12 tab, 8 ref.

Descriptors: *Dry farming, *Rainfall, *Seasonal variation, *Mozambique, *Planting management, Simulation, Hydrologic budget, SWETAM Model, Sorghum, Corn, Farm management, Sowing strategies, Risks, Social aspects, Human behavior, Water deficit, Yield.

Yearly rainfall characteristics of the sandy uplands and coastal zone of Southern Mozambique were analyzed with the aim of evaluating sowing strategies employed for rainfed crops. The SWETAM (Soil Water Extraction Thornthwaite and Mather) model was developed to simulate yields for maize (Zea mays) and sorghum (Sorghum vulgare) for two stations in southern Mozambique over a period of about 30 yr. For every year, each month with sufficient rainfall was considered to be a sowing period and for the subsequent growing period the water-balance terms of crop and soil were calculated. Yield reduction as a consequence of water deficiency was analyzed. Results of the simulation indicate that, for rainfed agriculture, the environmental conditions are very risky. For each station, yields vary greatly from year to year. Plant density and depth of root zone seem to be important characteristics that influence water deficit and yield reduction under the prevailing meteorological conditions. From the subsistence farmer's point of view, it seems rational to sow frequently over a long period. This strategy is based on spreading risks and short-term interests rather than maximizing production over a longer period. This may be the best way to secure a minimum of food each year, but it leads to high seed losses. (Rochester--PTT)
W89-04208

MODELLING AND SIMULATION IN HYDROLOGIC SYSTEMS RELATED TO AGRICULTURAL DEVELOPMENT: STATE OF THE ART,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 3F.
W89-04266

2J. Erosion and Sedimentation

TECHNIQUES FOR MEASURING RESERVOIR BANK EROSION,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 7B.
W89-03343

ASSESSMENT OF THE ROLE OF BOTTOMLAND HARDWOODS IN SEDIMENT AND EROSION CONTROL.
Fish and Wildlife Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W89-03351

MAINSTEM AND OVERBANK FLOW SEDIMENT MOVEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Andrew.
IN: Assessment of the Role of Bottomland Hardwoods in Sediment and Erosion Control. Report No. NERC-88/11, February 1988. p 9-27, 7 fig, 7 tab.

Descriptors: *Streamflow, *Overland flow, *Forest hydrology, *Sediment transport, *Hardwood, *Sediment control, Erosion control, Hydrologic studies, Sedimentation, Vegetation, Wetlands.

During the last 180 years, agricultural and general developmental changes within the Yazoo Basin have increased overall sediment loads in the mainstem and tributaries. In general, degradation has occurred within the eastern hills, and consequent aggradation within the delta streams. Previous studies have indicated that, for complete tributary diversions, trap efficiencies of 95% may be attained initially, and long term trap efficiencies of 70% are realistic for the bottomlands of the delta. Diversion of overbank flows on Ascalamore Creek to bottomland hardwood areas functioning as sediment detention ponds could remove a maximum 24% of the total sediment load from the stream. Reduction of the existing overbank height by approximately 1 foot would increase this percentage to approximately 41%. If the entire creek was diverted through this area, it is anticipated that approximately 70% of the total sediment load would be removed during a 50-year period. (See also W89-03351) (Lantz-PTT)
W89-03352

DESCRIPTION OF LANDSCAPE SEDIMENT MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
A. Molinas.
IN: Assessment of the Role of Bottomland Hardwoods in Sediment and Erosion Control. Report No. NERC-88/11, February 1988. p 28-39, 2 fig, 2 tab.

Descriptors: *Watersheds, *Forest hydrology, *Soil loss, *Sedimentation, *Model studies, *Soil erosion, Sediment transport, Cartography, Simulation analysis, Mathematical models.

A watershed sediment routing model (HEC1WS) is described that operates on landscape information organized in the MOSS digital Geographic Information System (GIS). The model relates the weight of sediment eroded-deposited per unit area to landscape features (soil type, topography, land use). The MOSS cartographic system is used to develop and modify the areal themes that constitute input to the simulation and to provide spatial display of the simulation output. The simulation model calculates the movement of water and sediment through complex watersheds. This model is designed for applications for which the sources of data are limited. The water routing is accomplished through the U.S. Army Corps of Engineers' HEC-1 Flood Routing Computer program as a subprogram. Sediment routing, which is coupled with the water routing, utilizes a sediment transport capacity-sediment availability concept. (See also W89-03351) (Lantz-PTT)
W89-03353

APPLICATION OF LANDSCAPE SEDIMENT MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
A. Molinas, and G. T. Auble.
IN: Assessment of the Role of Bottomland Hardwoods in Sediment and Erosion Control. Report No. NERC-88/11, February 1988. p 40-60, 17 fig, 1 tab.

Descriptors: *Forest hydrology, *Model studies, *Sedimentation, *Yazoo River, *Computer models, *Hardwood, Mississippi, Erosion control, Sediment control, Sediment transport, Soil erosion, Erosion.

The HEC1WS computer model is applied to a section of the delta or bottomlands of the Yazoo River Basin in Mississippi. The objectives of the application were to assess the practical aspects of using the model and the general reasonableness of model output and to evaluate the function of bottomland hardwoods in controlling sediment flux from the landscape. To address these objectives, 14 computer runs were performed representing various proportions and spatial configurations of bottomland hardwoods in the landscape. Results indicate that by increasing the bottomland hardwoods cover type, and possibly other forested cover types can reduce sediment loss, by limiting sediment availability, and therefore sediment trapping. (See also W89-03351) (Lantz-PTT)
W89-03354

DETERMINATION OF NATURAL RADIONUCLIDES IN A COASTAL MARINE SEDIMENT:

AN ANALYSTS' INTERCOMPARISON EXERCISE,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Research.
For primary bibliographic entry see Field 5A.
W89-03397

EXTENSION OF THE GRID-BASED HYDROLOGICAL MODEL CEQUEAU TO SUSPENDED SEDIMENT MOVEMENT THROUGH DRAINAGE BASINS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, D. Cluis, and G. Morin.
Water Research WATRAG, Vol. 22, No. 8, p 991-999, August 1988. 5 fig, 2 tab, 21 ref. Natural Sciences and Engineering Research Council Grants No. 9164 and A3711. Ministere de l'Education of the Province of Quebec Grant No. FCAR 2104.

Descriptors: *Erosion, *Drainage basins, *Mathematical models, *Suspended sediments, *Hydrologic models, *Sediment transport, Fluvial sediments, Sedimentation, Water quality, Adsorption, Path of pollutants, Mathematical studies, Numerical analysis, Suspended solids, Bank erosion.

An original attempt is made to describe an integrated conceptual approach to the genesis and transport of suspended solids. The key points of this approach are that: (1) the hydrological representation is provided by a numerical model (CEQUEAU) which is also used to define the spatial square grid for the transport of suspended solids, and (2) the model makes use of two main functions: (a) a production function which considers drainage basin erosion and river bank erosion. For both of these it evaluates the amount of material, in each granulometric class, that is available for transportation; (b) a transport function which takes into account the sedimentation/resuspension phenomena that occur within the river during hydrological events. One of the advantages of this approach is that it permits the isolation of a particular granulometric class of SS that might be ecologically important, such as the adsorption of toxic material on fine particles. This model, which is part of a conceptual water quality model called CEQUAL, has been tested on the Ste-Anne de la Perade river, and the accuracy of the results is discussed. (Author's abstract)
W89-03436

SUSPENDED MATTER AND BOTTOM DEPOSITS IN THE MARONI ESTUARINE SYSTEM (FRENCH GUIANA),
Institut de Geologie du Bassin d'Aquitaine, Talence (France).
For primary bibliographic entry see Field 2L.
W89-03536

PHOSPHORUS BIOAVAILABILITY OF FLUVIAL SEDIMENTS DETERMINED BY ALGAL ASSAYS,
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 2H.
W89-03572

SUSPENDED-SEDIMENT, BOTTOM-MATERIAL, AND ASSOCIATED-CHEMICAL DATA FROM THE LOWER MISSISSIPPI RIVER, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. R. Demas, and P. B. Curwick.
Water Resources Basic Records Report No. 14, 1987. 117p, 6 fig, 11 tab, 13 ref.

Descriptors: *Water chemistry, *Bottom sediments, *Water quality, *Suspended sediments, *Louisiana, *Chemical analysis, *Mississippi River, Monitoring, Particle size, Organic compounds, Sedimentation, Channel morphology, Dredging.

Suspended sediment was collected monthly along the lower Mississippi River, at eight fixed sites from December 1982 to February 1985. Six of these sites were sampled on a regular basis for total-recoverable and dissolved minor elements in the water column. All of the monthly suspended sediment sites were sampled periodically for minor elements in separate particle size fractions of suspended sediment and bottom material. Several of these sites also were sampled for trace organic compounds in whole water, filtered water, and bottom material. Discharge was concurrently measured with water quality sampling. Suspended sediment also was sampled intensively during six steady-flow conditions every 5 to 10 river miles from Tarbert Landing, Mississippi, to Venice, Louisiana. Suspended sediment concentrations were determined. Suspended sediment was never collected at any site when saltwater was present at the site. Specialized sampling equipment used to dewater suspended sediment in the field and laboratory methods and techniques used during this project are described. The resultant discharge and water quality data are reported in tabular form. (Author's abstract)
W89-03755

SUSPENDED-SEDIMENT CHARACTERISTICS OF THE YANTIC RIVER AT YANTIC, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp.
Connecticut Water Resources Bulletin No. 39, 11983. 34p, 10 fig, 8 tab, 15 ref.

Descriptors: *Suspended sediments, *Yantic River, *Streamflow, Connecticut, Sediment transport, Storms.

Daily suspended sediment and streamflow data were collected at the Yantic River at Yantic, Connecticut, from October 1975 through September 1980, as part of a program to determine the suspended sediment characteristics of Connecticut streams. The data represent a rural, wooded, and agricultural drainage basin of 90 sq mi in the highlands of southeastern Connecticut. Daily mean suspended sediment concentrations ranged from 0 to 168 mg/L, with a mean for the period of 5 mg/L. Daily suspended sediment discharges ranged from 0 to 2,060 tons; loads were < 0.70 tons/day for 50% of the time, and were in excess of 7 tons/day for less than 10% of the time. A total of about 19,600 tons of suspended sediment were transported during storms; four storms were responsible for 48% of the suspended sediment exported. The average annual suspended sediment yield from the drainage basin was estimated to be 50 to 60 tons/sq mi. (Author's abstract)
W89-03771

GEOLOGY, WATER MOVEMENT, AND SEDIMENT CHARACTERISTICS OF THE SUGAR, ROMAINE, AND ROCK CREEK BASINS, JEFFERSON COUNTY, MISSOURI,
Geological Survey, Rolla, MO.
For primary bibliographic entry see Field 5B.
W89-03779

EROSION OF COHESIONLESS SEDIMENT BY GROUNDWATER SEEPAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. D. Howard, and C. F. McLane.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1659-1674, October 1988. 12 fig, 4 tab, 39 ref.

Descriptors: *Sediment erosion, *Groundwater movement, *Seepage, *Soil erosion, *Spring sapping, *Cohesionless soils, Fluvial zone, Sapping zone, Mathematical models.

Surface grains of noncohesive sediment eroded by emerging groundwater are acted upon by 3 forces, the tractive force of the cumulative surface flow contributed by upslope seepage, the local seepage force, and gravity. The balance of the force moments determines the mode and rate of transport. Seepage forces are strong in a narrow 'sapping zone' at the upstream end of the emerging flow, where erosion occurs by mass movement and the surface gradient is determined by the balance of the seepage and gravity moments. Most of the erosion occurs in this zone, and the resultant backcutting triggers intermittent failure of overlying slopes in an 'undermining zone' maintained at the angle of repose of the dry or damp sediment. In the 'fluvial zone' downstream from the sapping zone the seepage force is small compared to the tractive force, and the transport occurs by normal fluvial traction. The overall rate of sapping erosion in noncohesive sediments is determined by the capacity of fluvial transport to remove sediment eroded in the sapping zone. Prediction of sapping rates is complicated by the interaction between the geometry of the fluvial and sapping zones and the quantity and spatial distribution of seepage. A simulation model incorporating a groundwater flow model and sediment transport relationships closely replicates the observed evolution of sapping erosion in a 2-dimensional tank filled with noncohesive sand subjected to lateral groundwater flow. (Author's abstract)
W89-03805

ROLES OF RAINFALL AND RUNOFF IN THE SEDIMENT TRANSPORT CAPACITY OF INTERRILL FLOW,
Guelph Univ. (Ontario). School of Engineering.
B. T. Guy, W. T. Dickinson, and R. P. Rudra.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1378-1386, September-October 1987. 8 fig, 3 tab, 31 ref.

Descriptors: *Soil erosion, *Sediment transport, *Erosion, *Rainfall, *Surface runoff, Rainfall intensity, Stream gradient, Overland flow, Interill flow, Mathematical models.

A laboratory study was conducted to examine the transport capacity of interrill flow. Experiments were performed in flows with and without rainfall to isolate the contributions to transport capacity from surface and raindrop impact. Theory and measurement indicated that the runoff contribution was determined by discharge and bedslope. The transport capacity was greatly enhanced by raindrop impact, and the enhancement depended on rainfall intensity and bedslope. Rainfall momentum and kinetic energy fluxes were also significant in explaining the transport enhancement. Interrill transport capacity equations based on the separate runoff and raindrop impact contributions were developed. Simpler equations, with the 2 contributions lumped, were also investigated. Rainfall-disturbed flows were better able to transport the larger particles of the sediment mixture. However, observations of restricted flow competence suggested that the transport capacity if interill flow is dependent on soil, as well as on hydraulic and rainfall properties. (Author's abstract)
W89-03831

REVISED SLOPE STEEPNESS FACTOR FOR THE UNIVERSAL SOIL LOSS EQUATION,
Agricultural Research Service, Pullman, WA.
D. K. McCool, L. C. Brown, G. R. Foster, C. K. Mutchler, and L. D. Meyer.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1387-1396, September-October 1987. 5 fig, 5 tab, 52 ref.

Descriptors: *Slope degradation, *Soil erosion, *Soil stability, *Erosion, *Mathematical models, *Rainfall, *Universal soil loss equation, Rill erosion, Interrill erosion.

A reanalysis of historical and recent data from both natural and simulated rainfall soil erosion plots has resulted in new slope steepness relationships for the Universal Soil Loss Equation. For long slopes on which both interrill and rill erosion occur, the relationships consist of 2 linear segments with a breakpoint at 9% slope. These relationships predict less erosion than current relationships on slopes steeper than 9% and slopes flatter than about 1%. A separate equation is proposed for the slope effect on short slopes where only interrill erosion is present. For conditions where surface flow over thaw-weakened soil dominates the ero-

sion process, 2 relationships with a breakpoint at 9% slope are presented. (Author's abstract)
W89-03832

SIZE DISTRIBUTION OF SEDIMENT AS AFFECTED BY SURFACE RESIDUE AND SLOPE LENGTH,
Agricultural Research Service, Lincoln, NE.
J. E. Gilley, S. C. Finkner, and G. E. Varvel.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1419-1429, September-October 1987. 5 fig, 2 tab, 19 ref.

Descriptors: *Erosion, *Runoff, *Sediment erosion, *Sediment distribution, *Soil erosion, *Rainfall, Sediment grading, Slope length, Surface residue.

Runoff samples for determination of size distribution of sediment were collected under simulated rainfall conditions at selected downslope distances on plots covered with sorghum and soybean residue at rates ranging from 0.00 to 6.73 t/ha. The effects of surface residue and slope length on size distribution of sediment were evaluated. Substantial movement of sediment in the form of aggregates was found for each of the residue treatments. Significant differences in size distribution of sediment occurred between residue treatments. For a given residue rate, differences in sediment size distribution were found between sorghum and soybean residue. Size distribution of sediment was also determined to be significantly different at selected downslope distances. (Author's abstract)
W89-03835

PHYSICAL AND CHEMICAL STUDIES ON THE SEDIMENTS OF THE ST-POINT LAKE (JURA MOUNTAINS): CARTOGRAPHY (ETUDE PHYSICO-CHIMIQUE DES SEDIMENTS DU LAC DE ST-POINT (MASSIF DU JURA): CARTOGRAPHIE THEMATIQUE),
Universite de Franche-Comte, Besancon (France). Lab. d'Hydrobiologie - Hydroecologie.
J. Verneaux, A. Guyard, D. Joly, and A. Vidonne.
Annales de Limnologie ANLIB3, Vol. 24, No. 1, p 15-29, 1988. 11 fig, 5 tab, 36 ref. English summary.

Descriptors: *Sediment distribution, *Sedimentology, *Lake sediments, *Mapping, Geologic mapping, Core logging, Physical analysis, Chemical analysis, Distribution patterns, France.

Physical and chemical analyses (pH, Eh, electrical conductivity, temperature, and dissolved oxygen) were made on 90 samples of the 180 sediment cores, taken at 30 sites of the lake bottom area, at several depths. The horizontal and vertical changes of the major parameters were analyzed. Six statistical maps show their spatial distributions and the outlines of the sedimentation processes. Thematic cartographs confirm (1) the effect of vegetation layers on carbonate precipitation and (2) the dual effect of the Doubs River which is beneficial because of its oxygenation of the lake water but detrimental because it brings an influx of nitrogen and phosphorus compounds which cause algal growths. (Vernooy-PTT)
W89-03843

POST-1847 CHANGES IN THE AVON-HEATHCOTE ESTUARY, CHRISTCHURCH: A STUDY OF THE EFFECT OF URBAN DEVELOPMENT AROUND A TIDAL ESTUARY,
Christchurch City Engineer's Dept. (New Zealand).
For primary bibliographic entry see Field 4C.
W89-03860

'FURKERT-HEATH' RELATIONSHIP FOR TIDAL INLET STABILITY REVIEWED,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2L.
W89-03861

POVERTY BAY, NEW ZEALAND: A CASE OF COASTAL ACCRETION 1886-1975,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2L.
W89-03862

EROSION AND DEPOSITION IN A FIELD/FOREST SYSTEM ESTIMATED USING CESIUM-137 ACTIVITY,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. Lowrance, S. McIntyre, and C. Lance.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 2, p 195-199, March-April 1988. 5 fig, 3 tab, 19 ref.

Descriptors: *Soil erosion, *Cropland, *Tracers, *Deposition, *Sedimentation, *Forest watersheds, Estimation, Cesium radioisotopes, Sediment erosion, Wetlands.

Soil erosion and deposition were estimated using Cs-137 activity within a 7.25-ha field/forest system in the southeastern coastal plain. Soil eroded from the field was deposited both in the riparian (streamside) forest ecosystem and in downslope areas of the field. Total activity, depth to peak activity, and depth to zero activity increased downslope from field to stream. Erosion and deposition rates, estimated by changes in activity per unit area from a reference undisturbed forest site, showed that about twice as much total deposition had taken place as total erosion. Excess deposition was attributed to deposition from the upstream portions of the watershed. Erosion and deposition rates estimated with this method were about 63 and 256 Mg/ha/yr, respectively. Erosion and deposition rates estimated by two different calculation techniques were nearly identical. These rates were considerably higher than rates estimated in an earlier study. The rates may be overestimated because the differential rates of Cs-137 movement on clay particles were not considered. The riparian ecosystem acted as a very efficient sediment trap. (Author's abstract)
W89-03894

CARBON MOVEMENT IN RUNOFF AND EROSION UNDER SIMULATED RAINFALL CONDITIONS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2E.
W89-03903

CLAY-MINERAL CONTRIBUTION TO THE WEATHERING MECHANISMS IN TWO CONTRASTING WATERSHEDS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5C.
W89-03917

SIZE AND SURFACE TEXTURE OF SEDIMENT IN AN URBAN CATCHMENT,
Exeter Univ. (England). Dept. of Geography.
A. H. Roberts, J. B. Ellis, and W. B. Whalley.
Science of the Total Environment STENDL, Vol. 72, p 11-27, June 15, 1988. 2 fig, 2 tab, 44 ref.

Descriptors: *Path of pollutants, *Urban runoff, *Particle size, *Sediments, *Storm water, *Storm runoff, Land use, Electron microscopy, Quartz, Silica, Sewer systems, Storm drains, Sediment load, Sampling, Classification, Construction materials, Catchment areas, Urban areas.

The size and surface texture of sediment collected in stormwater runoff from an urban catchment of 420 hectares in NW London were examined. The area comprised mixed urban land uses drained by a separate sewer system. Seven land-use classes were recognized as sediment sources. Sediment was examined using an electronic particle counter and scanning electron microscopy. A Fuzzy Classification Technique was used to analyze the micrographs. Sediment composition varied, but that reaching the sewer system was predominantly quartz particles, less than 100 micrometers, and of abraded appearance. Early stages of silica precipitation on particles were noted. (Author's abstract)
W89-03940

SEDIMENT AND ELEMENTAL ASSIMILATION RATES IN THE KRISHNA RIVER BASIN, INDIA,
McGill Univ., Montreal (Quebec). Dept. of Geological Science.
R. Ramesh, V. Subramanian, and K. C. Pillai.
Science of the Total Environment STENDL, Vol. 72, p 221-226, June 15, 1988. 2 fig, 3 tab, 12 ref.

Descriptors: *Estuaries, *Deposition, *Sediments, *India, *Sedimentation rates, *Lead, *Accumulation, *Rivers, Erosion rates, Flocculation, Krishna River Silicon, Aluminum, Magnesium, Calcium, Sodium, Potassium, Phosphorus, Clays, Chemical analysis, Aquatic environment.

Rates of sedimentation in sediment cores collected from the Krishna River basin in India were determined by the excess Pb-210 technique. An average rate of 5.5 mm per year, obtained for the entire basin, is higher than the computed erosion rate, 0.17 mm per year, suggesting local sources such as bank erosion, etc., for the sediments. The high rates prevalent in the estuarine zone reflect rapid sedimentation due to flocculation. The deposition rates of major and minor elements in the Krishna River basin during the last 10-50 years are considerably higher than those of the estuarine of Bay or Bengal sediments. (Author's abstract)
W89-03948

SEDIMENT DEPOSITION BEHIND SHEEP CREEK BARRIER DAM, SOUTHERN UTAH,
Bureau of Land Management, Denver, CO.
B. P. Van Haveren, W. L. Jackson, and G. C. Lusby.
Journal of Hydrology JHYDA7, Vol. 26, No. 2 p 185-196, 1987. 6 fig, 2 tab, 14 ref.

Descriptors: *Dam effects, *Reservoir silting, *Silting, *Sediments, *Deposition, *Utah, Streams, Runoff, Sedimentations, Sediment load, Geological surveys, Slopes, Reservoirs, Channels, Channel accretion, Aggradation, Soil erosion.

Reservoir and channel cross-sections were surveyed periodically over a 25-year period to determine sediment deposition and channel aggradation behind the Sheep Creek Barrier Dam in southern Utah. The reservoir below the spillway elevation was almost completely filled with sediment in 1961, one year following dam completion. Subsequent surveys indicated continuing deposition above the spillway elevation. Annual deposition for the period 1960-1984 averaged 18.2 x 1000 cubic meters per year, while deposition for the most recent measurement peiod, 1969-1984, averaged 12.8 x 1000 cubic meters per year. Channel deposition by April, 1984, extended 1424 meters upstream from the dam to an elevation of 18 meters above the spillway crest. An active channel has formed in the sediment deposit. Bankfull capacity of this channel is low compared to commonly experienced flows, but should increase as deposition proceeds. The ratio of the deposition channel slope to the original channel slope is presently 0.83. (Author's abstract)
W89-03968

HYDROCHEMICAL STUDY OF URBAN LANDSLIDES CAUSED BY HEAVY RAIN: SCARBOROUGH BLUFFS, ONTARIO, CANADA,
Scarborough Coll., Westhill (Ontario). Dept. of Geology.
N. Eyles, and K. W. F. Howard.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 3, p 455-466, August 1988. 6 fig, 4 tab, 36 ref.

Descriptors: *Urban areas, *Canada, *Landslides, *Hydrology, *Excess rainfall, *Geology, Slope degradation, Surface water, Interstitial water, Climatic data, Erosion, Stratigraphy, Sediments, Discharge measurement, Runoff, Clays, Slopes, Ontario, Recharge, Infiltration, Soil types, Interception, Drainage, Erosion control.

Scarborough Bluffs is a 15 km long stretch of the Lake Ontario shoreline east of downtown Toronto. This heavily urbanized area currently represents Canada's most serious erosion problem. The worst affected zone is 1.5 km long and lies along South Marine Drive where 50 m high bluffs are failing by shallow retrogressive failures of jointed glacial clays over underlying deltaic sands and clays. The erosion rate is about four times that for the coastline as a whole. Heavy rains in the Toronto area in August and September 1986 produced a spate of slope failures and mud flows. Particularly heavy storms on September 10 and 29 triggered extensive retrogressive slope failures at South Marine Drive. Hydrochemical investigations of discharged waters suggest that slope failure was caused by surface runoff on the bluff top recharging lower slope areas by infiltration through joints in the upper clay capping. Discharge of water from the lower slope is impeded by less permeable barriers in the deltaic stratigraphy at the site and by a cover of clayey slope debris. Data suggest that provision for adequate drainage of the bluff top, by interceptor drains, is a prerequisite for controlling slope behavior in the area. (Author's abstract)
W89-03970

HYDROLOGY AND LONG-TERM GEOMORPHIC SIGNIFICANCE OF A FLASH FLOOD IN THE CAIRNGORM MOUNTAINS, SCOTLAND,
College of St. Paul and St. Mary, Cheltenham (England). Dept. of Geography and Geology.
For primary bibliographic entry see Field 2E.
W89-03975

MODELING SUSPENDED SEDIMENT TRANSPORT IN NONEQUILIBRIUM SITUATIONS,
West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
I. Celik, and W. Rodi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1157-1191, October 1988. 13 fig, 1 tab, 32 ref, 2 append.

Descriptors: *Model studies, *Sediment transport, *Suspended sediments, *Hydraulics, Mathematical models, Sediments, Flow, Channel flow, Engineering, Hydraulic engineering, Turbulent flow, Hydrodynamics, Eddy diffusion, Sedimentation, Friction, Boundary conditions, Entrainment.

A mathematical model is presented for calculating suspended sediment transport in unidirectional channel flow under general, nonequilibrium conditions. The model consists of a flexible hydrodynamic component for calculating the flow field and the turbulence characteristics and a scalar transport model. The kappa-epsilon turbulence model provides the distribution of velocity and eddy diffusivity as well as the friction velocity. The settling process is simulated with an empirical settling velocity appearing in the particle concentration equation. As a boundary condition for this equation, the net flux of sediment to and from the bed is prescribed with a new model which covers both fixed-bed and erodable-bed situations. The net flux is expressed as the difference between deposition to and entrainment from the bed and, while the deposition rate is known from the local concentration and settling velocity, the entrainment is assumed to occur at the same rate as it does under equilibrium conditions, provided sufficient sediment material is available. With the aid of a finite volume procedure, the combined hydrodynamic sediment transport model was applied to a variety of flume experiments involving zero net flux, net-deposition, and net-entrainment situations. The predicted development of the vertical concentration profiles was compared with the measurements and generally good agreement was obtained. (Author's abstract)
W89-03976

TWO-DIMENSIONAL LAGRANGIAN SIMULATION OF SUSPENDED SEDIMENT,
Geological Survey, Tampa, FL.
D. H. Schoellhamer.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1192- 1209, October 1988. 10 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Simulation, *Suspended sediments, *Model studies, *Sediment transport, *Hydraulics, Sediments, Boundary conditions, Flow, Engineering, Hydraulic engineering, Optimization, Streams, Stability analysis, Sensitivity analysis, Mathematical models, Convection, Mixing, Erosion.

A two-dimensional laterally averaged model for suspended sediment transport in steady gradually varied flow is based on the Lagrangian reference frame. The layered Lagrangian transport model (LLTM) for suspended sediment performs laterally averaged Lagrangian calculations with steady or unsteady upstream boundary concentration. The elevations of nearly horizontal streamlines and the simulation time step are selected to optimize model stability and efficiency. The computational elements are parcels of water that are moved along the streamlines in the Lagrangian sense and are mixed with neighboring parcels. The bottom boundary condition can be either a near-bed concentration or a sediment pick-up rate. Three applications show that the LLTM can accurately simulate theoretical and empirical nonequilibrium suspended sediment distributions and slug injections of suspended sediment in a laboratory flume. (Author's abstract)
W89-03977

DESIGN METHOD FOR LOCAL SCOUR AT BRIDGE PIERS,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-03978

CRITICAL SCOUR: NEW BED PROTECTION DESIGN METHOD,
Delft Geotechnics (Netherlands).
For primary bibliographic entry see Field 8B.
W89-03979

CRITICAL SHEAR STRESS OF COHESIVE BOTTOM SEDIMENTS,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
K. Otsubo, and K. Muraoka.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1241- 1256, October 1988. 11 fig, 2 tab, 13 ref, 2 append.

Descriptors: *Scour, *Channel erosion, *Shear stress, *Bottom sediments, *Sediment transport, *Rheology, *Hydraulics, Sedimentation, Stress, Sediments, Mud, Flow, Flow characteristics, Engineering, Hydraulic engineering, Viscosity, Physical properties.

The main purpose of this study is to obtain a simple critical shear stress function for cohesive soft bottom sediments. A series of experiments concerning threshold levels of mud transport and two series of tests of their rheological and setting properties were conducted to find some correlation among these indices. Two threshold levels were defined for mud transport and muds were divided into two groups by their characteristics (settling type, flow curve, resuspension behavior, etc.). In discussing the factors determining the characteristics of the two groups, it was found that natural muds usually belong to the first group, in which the two critical shear stresses are given as a function of yield value tau sub gamma 1 (defined in paper) independent of material, following a new definition of threshold for sediment detachment from the bed. Finally, the correlation between this yield value and the final settling volume ratio is also discussed. (Author's abstract)
W89-03980

SEDIMENT SOURCES IN THE LAKE TAHOE BASIN, CALIFORNIA-NEVADA: PRELIMINARY RESULTS OF A FOUR YEAR STUDY, AUGUST 1983 - SEPTEMBER 1987,
Geological Survey, Menlo Park, CA. Water Resources Div.
B. R. Hill, J. R. Hill, and K. M. Nolan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-333, 1988. 38p, 7 fig, 30 tab, 10 ref.

Descriptors: *California, *Sediment yield, *Soil erosion, *Hillslope erosion, *Lake Tahoe Basin, *Sediment load, Erosion, Nevada, Sediment discharge, Stream banks, Streambeds, Stream channel, Mapping, Suspended sediments.

Data were collected during a 4-yr study of sediment sources in four drainage basins tributary to Lake Tahoe, California-Nevada. The study areas include the Blackwood, General, Edgewood, and Logan House Creek basins. Data include changes in bank and bed positions at channel cross sections; results of stream-channel mapping; analyses of bank and bed material samples; tabulations of bed material point counts; measured rates of hillslope erosion; dimensions of gullies; suspended-sediment data collected during synoptic snowmelt sampling; and physiographic data for the four study basins. (USGS)
W89-04030

HYDRAULIC AND CHANNEL CHARACTERISTICS OF SELECTED STREAMS IN THE KANTISHNA HILLS AREA, DENALI NATIONAL PARK AND PRESERVE, ALASKA, 1982-84,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04033

HYDROLOGIC AND SUSPENDED-SEDIMENT DATA FOR REELFOOT LAKE, OBION AND LAKE COUNTIES, NORTHWESTERN TENNESSEE, MAY 1985-SEPTEMBER 1986,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04039

PILOT STUDY FOR COLLECTION OF BRIDGE-SCOUR DATA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-04062

GEOCHEMICAL STUDIES OF ORGANIC CARBON ASSOCIATED WITH MOUNT ST. HELENS' VOLCANIC ASH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-04098

CONFIDENCE LIMITS FOR DETERMINING CONCENTRATIONS OF TRACER PARTICLES IN SEDIMENT SAMPLES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04101

DETERMINING STREAMFLOW CHARACTERISTICS BASED ON CHANNEL CROSS-SECTION PROPERTIES-STATE OF THE ART,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04103

GROUND-PENETRATING RADAR STUDY OF THE THICKNESS AND EXTENT OF SEDIMENTS BENEATH SILVER LAKE, BERLIN AND MERIDEN, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04107

ESTIMATED SEDIMENT DEPOSITION IN LAKE CORPUS CHRISTI, TEXAS, 1972-85,

Geological Survey, Austin, TX. Water Resources Div.
N. F. Leibbrand.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-239, 1987. 26p, 1 fig, 6 tab, 10 ref.

Descriptors: *Sediment loads, *Texas, *Lakes, *Silting, Regression analysis, Sediment deposition, Sedimentation, Discharge, Lake Corpus Christi.

Investigation of sediment deposition in Lake Corpus Christi, Texas, was initiated by studying the published and unpublished sediment data for the 1972-85 water yr for stations located upstream and downstream of the lake. Regression analysis was used to fill in the missing data. Data were tabulated for monthly discharge (acre-ft) and sediment load (tons, acre-ft, and percent by weight). Yearly totals and cumulative averages were computed and included in the tables. An estimated 10,300 acre-ft (wet volume) of sediment has been deposited in Lake Corpus Christi during the 14-yr period of record (1972-85), an average of 736 acre-ft/yr (wet volume). An earlier study by the U.S. Soil Conservation Service, based on 1942-48 changes of lake bottom contours, estimated that 736 acre-ft/yr of suspended sediment had entered Lake Corpus Christi during that 6-yr period. Some difference was found in comparison of the results of the U.S. Geological Survey (Water Resources Division) study and the McCaughan and Etheridge Consulting Engineers study. Total sediment outflow from Lake Corpus Christi was estimated at 177 acre-ft (dry) by the Geological Survey and 1,070 acre-ft (dry) by McCaughan and Etheridge Consulting Engineers. This difference may be due to construction of a new dam, completed in 1958, that is higher and inundated the old dam. (USGS)
W89-04136

HYDRAULIC RESISTANCES AND SEDIMENT DISCHARGE IN THE CASE OF BED RIPPLES,
For primary bibliographic entry see Field 8B.
W89-04199

PHOSPHORUS TRANSPORT MODEL FOR SMALL AGRICULTURAL WATERSHEDS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-04217

RIVER DYNAMICS AND VEGETATION MOSAICISM: A CASE STUDY OF THE RIVER KAMAJOHKA, NORTHERNMOST FINLAND,
Turku Univ. (Finland).
For primary bibliographic entry see Field 2E.
W89-04311

PREDICTION OF DRAIN SILTING BY SOIL AGGREGATE SIZE ANALYSIS,
Laval Univ., Quebec.
R. Lagace, and W. Skaggs.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 796-803, May-June 1988. 6 fig, 6 tab, 33 ref.

Descriptors: *Silting, *Soil analysis, *Particle size, *Soil aggregates, *Drains, Erosion, Aggregates, Prediction, Soil texture, Soil structure, Excavation, Sieve analysis, Sediment erosion, Drainage systems, Sampling, Sediments.

Fifty-four drains on 10 Quebec farms were excavated and examined. On every site, soil samples were taken and drain opening characteristics determined. Drain silting depth was correlated to particle size and aggregate size. The wet sieving technique preceded by vacuum saturation was used for the aggregate size analysis. The correlation between sediment depth and aggregate size distribution was high even though the wet sieving technique produced highly variable results. The wet sieving technique offers potential but needs improvement before final criteria can be developed and its use can be generalized. (Author's abstract)
W89-04383

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART I. MODEL DEVELOPMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
M. C. Hirschi, and B. J. Barfield.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 804-813, May-June 1988. 9 fig, 38 ref.

Descriptors: *Rainfall, *Rill erosion, *Computer programs, *Model studies, *Runoff, *Soil erosion, Erosion, Rills, Sediments, Mathematical equations, Fortran.

The Kentucky Erosion Model (KYERMO) was developed as a research tool to isolate the important aspects of the rainfall/runoff/erosion process. The model consists of a main program and 37 subroutines and functions. It was written in Microsoft FORTRAN, which is a subset of the ANSI FORTRAN 77 standard, thus the program can be run on other computers with few modifications. The main program structure utilized the Meyer and Wischmeier conceptual model for the erosion process with the plot divided into slope increments and rill watershed on each increment. The framework formed by the MAIN program and the support routines has four components: (1) runoff-generation component, (2) runoff-routing component, (3) sediment-generation component, (4) sediment-routing components. The runoff-generation components includes a surface-storage calculation routine, an infiltration routine, and a runoff calculation routine. The runoff-routing components has three subroutines, each of which is used to route runoff through the dynamic rill network where cross sections are changed with time in response to changes in the detachment of sediment. The sediment-generation routines calculate processes of raindrop detachment, rill-flow detachment, rillway sloughing, and change of the rill channel cross section caused by detachment. In the sediment-routing component, transport and deposition of sediment is calculated for both sheet-flow and rill-flow mechanisms. Each of the basic sediment-transport equations in this model has been shown to be applicable to shallow-flow application. (See also W89-04385) (Stoehr-PTT)
W89-04384

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART II. MODEL SENSITIVITY ANALYSIS AND TESTING,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
M. C. Hirschi, and B. J. Barfield.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 814-820, May-June 1988. 9 fig, 4 tab, 11 ref.

Descriptors: *Sensitivity analysis, *Runoff, *Model studies, *Soil erosion, Model testing, Erosion, Soil conservation, Rills, Mathematical equations, Slopes, Simulation, Prediction, Optimization, Storm runoff, Channels.

KYERMO (Kentucky Erosion Model) was found to represent erosion processes adequately for the field data collected, especially in comparison with other erosion models. The physical basis for its development will also all further modifications to extend our knowledge of the erosion process. The model simulated the field erosion data with reasonable accuracy, with a standard error within the range of other studies reported in the literature. Simulation accuracy could be greatly increased by utilizing optimized parameters. The need for parameter value optimization methods was quite evident in the analysis, consistent with the results from other researchers. It can be concluded that the erosion model produces the proper trends, and that the relative effects of parameters may be evaluated with reasonable confidence for steep slopes, but the lack of information for estimating detachment parameter values limits the use of the model for determining absolute erosion amounts. The sensitivity analysis indicated that the model predictions followed the expected trends for the steep slope (detachment limiting) case. These analysis further indicate that predictions should be based on the highest practical number of slope increments. The results also indicate that the number of rills on a given plot that causes a maximum erosion rate are different for different soil conditions and storm runoff volumes. (See also W89-04384) (Stoehr-PTT)
W89-04385

USE OF THE EINSTEIN ENTRAINMENT FUNCTION FOR PREDICTING SELECTIVE ENTRAINMENT AND DEPOSITION OF HEAVY MINERALS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
C. S. James.
Water SA WASADV, Vol. 14, No. 4, p 219-228, October 1988. 7 fig, 60 ref.

Descriptors: *Sedimentation, *Sediment transport, *Entrainment, *Mathematical studies, *Deposition, *Minerals, *Sediment sorting, Sediments, Quantitative analysis, Particle size, Spatial distribution, Bed load, Suspended load, Hydraulics, Prediction, density, Hydraulic roughness, Boundary conditions.

Einstein's entrainment probability function is investigated as a means for describing size-density sorting of sediment during entrainment into and deposition from transport by intermittent suspension. The function is first compared with the Shields entrainment criterion and shows good agreement in the hydraulically rough zone. Results in the transition zone are sensitive to description of the hiding factor, which remains uncertain. The predicted effect of bed roughness on entrainment from a non-uniformly sized bed is shown to be consistent with observed behavior. Application of the model to describe sorting by selective deposition and entrainment is illustrated. The Einstein function is incorporated as a boundary condition in a numerical diffusion-convection model for describing the distribution of suspended load under steady, longitudinally uniform flow conditions. This model can be used to predict the spatial distribution and local composition of sediment deposited from suspended load. Hypothetical applications of the model show that it is meaningless to apply sorting criteria at isolated sections in a stream. Temporal and spatial variations of bed material and hydraulic conditions should also be accounted for. (Author's abstract)
W89-04393

ONE-DIMENSIONAL MODEL FOR THE TRANSPORT OF A SEDIMENT MIXTURE IN NON-EQUILIBRIUM CONDITIONS,
Trento Univ. (Italy).
A. Armanini, and G. Di Silvio.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 275-292, 1988. 4 fig, 27 ref.

Descriptors: *Mathematical models, *Sediment transport, *Erosion, *Deposition, Non-equilibrium conditions.

The non-stationary one-dimensional continuity equations of each granulometric class of sediments were written for the waterstream (suspended transport), the bottom layer (bedload transport) and the mixing layer below the bottom surface. Proper closure equations have been introduced to express the transversal sediment fluxes between these three layers, accounting for the different adaptation-length of each grain-size class. A number of examples are given, showing the importance of non-equilibrium for non-uniform particles in erosion-deposition processes at a short time scale. The mathematical model developed is able to explain: (1) the lag between the suspended transport and the transport capacity of the stream, and (2) the lag between the actual grain size composition of the streambed and the streambed composition when the equilibrium with the transport is attained. (Brock-PTT)
W89-04418

WATER WAVES GENERATED BY DISTANT LANDSLIDES,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.

W89-04420

NONLINEAR HYPERBOLIC SYSTEM AND ITS SOLUTIONS FOR AGGRADED CHANNELS,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
H. Zhang, and R. Kahawita.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 323-342, 1988. 9 fig, 1 tab, 23 ref, append.

Descriptors: *Mathematical models, *Sediment transport, *Alluvial rivers, *River beds, *Alluvial channels, Hydraulic structures, Water management, Channel morphology.

A one-dimensional nonlinear hyperbolic model has been developed to describe the unsteady sediment transport rate in an alluvial channel. Solutions that are independent of other physical quantities involved have been obtained. This system, when used to evaluate the long time morphological changes due to constant upstream overloading, can be well approximated by one or two second-order ordinary differential equations. An implicit numerical scheme has been developed to verify of the present nonlinear equation and its asymptotic solutions. In deriving the governing equation, a minimum of restrictive assumptions have been invoked. The results have been appraised by comparing them with the exact solutions to a linear model as well as with currently available experimental data. (Author's abstract)
W89-04421

FIELD ASSESSMENT OF SEDIMENT TRAP EFFICIENCY UNDER VARYING FLOW CONDITIONS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. T. Baker, H. B. Milburn, and D. A. Tennant.
Journal of Marine Research JMMRAO, Vol. 46, No. 13, p 573-592, August 1988. 11 fig, 2 tab, 18 ref.

Descriptors: *Mathematical studies, *Samplers, *Sediment transport, *Sediment samplers, *Sediment yield, Estuaries, Tidal effects, Flow conditions.

Knowledge of the collection efficiency of sediment traps, particularly under conditions of varying current speed, is more a matter of hope than confidence. A field experiment designed to determine, for a particular trap geometry, the effect of current speed and particle fall velocity on the collection efficiency of a moored trap relative to the presumably unbiased efficiency of an identical drifting trap is discussed. The experiment was performed in a deep estuarine tidal passage where a smoothly varying unidirectional flow and a spatially homogeneous particle population mimicked laboratory flume conditions. A multiple-sample sediment trap integrated to a current meter partitioned the mass flux collected by the moored trap into one of four chambers according to the following speed intervals: <12, $12-<30$, $30-<50$, and $>$ or $=50$ cm/s. The magnitude and particle characteristics of the flux collected at <12 cm/s were indistinguishable from those simultaneously collected by drifting traps. At higher speeds, the relative efficiency of the moored trap ranged between 1 and 24% and the mean size and density of the trapped particles increased. These results support predictions based on laboratory studies that collection efficiency decreases with an increase in the trap Reynolds number or a decrease in particle fall velocity. Consideration must be given to scaling both trap diameter and aspect ratio according to the expected flow conditions, and that knowledge of flow conditions at the trap mouth is necessary to properly interpret the flux data. (Author's abstract)
W89-04422

COMPARISON OF SEDIMENTATION RATES IN THE NATAL VALLEY, SOUTH-WEST INDIAN OCEAN, WITH MODERN SEDIMENT YIELDS IN EAST COAST RIVERS OF SOUTHERN AFRICA,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
A. K. Martin.
South African Journal of Science SAJSAR, Vol. 83, No. 11, p 716-724, November/December 1987. 5 fig, 2 tab, 76 ref.

Descriptors: *Sedimentation rates, *Sediment yield, *Indian Ocean, *Rivers, *Geologic history, *South Africa, Seismology, Tectonics, Micropaleontology, Dating, Deposition, Marine sediments, Sedimentology, Erosion rates, Soil erosion, Land use.

Sediment volumes in the northernmost Natal Valley have been estimated using 4770 km of seismic reflection profiles. The total volume deposited in the basin, and that accumulated since the formation of the regional acoustic reflector 'Jimmy', have been calculated. The age of formation of the sedimentary basin has been gaged using seafloor-spreading magnetic anomalies and plate-tectonic reconstructions, while reflector 'Jimmy' has been dated micropaleontologically. Recent compilations provide estimates of the sediment yields of rivers draining into the Natal Valley. Using the average carbonate content of seafloor samples, a revised estimate of biogenic input to the ocean was made, which is within the range of values obtained by sediment-trapping experiments elsewhere. Modern rates of sediment supply are 12 to 22 times greater than the geological average for the Natal Valley. An independent study on the Tugela River catchment suggests modern sediment yields are 15 times higher than those in the past. Sediment volumes in the Natal Valley suggest that between 564 and 1033 m of rock have been eroded from the entire hinterland in the last 100 Myr. Independent estimates for the Karoo, highveld, and Lesotho suggest 1400 m of erosion over approximately 110 Myr. The great increase in modern sediment yields may be ascribed to man's influence. The pressing need is for farmers and environmental managers to reform land-use practices. (Author's abstract)
W89-04439

LABORATORY STUDIES ON THE INITIATION OF DENSITY CURRENTS BY INFLOWS TO LAKES AND RESERVOIRS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2H.
W89-04479

LITTORAL VS PROFUNDAL COMPONENTS OF SEDIMENT ACCUMULATION: CONTRASTING ROLES AS PHOSPHORUS SINKS,
Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 2H.
W89-04518

SEDIMENTATION MECHANISM OF FINE MATERIALS IN LAKE BIWA,
Geological Survey of Japan, Yatabe. Marine Geology Dept.
Y. Inouchi, and S. Terashima.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 567-572, January 1988. 7 fig.

Descriptors: *Limnology, *Sedimentation, *Lake Biwa, *Model studies, *Sediment transport, Chemical properties, Chemical analysis, Japan, Maps, Remote sensing, Copper, Zinc, Lead, Heavy metals, Sedimentology.

Lake Biwa, which lies to the west of central Japan, has an area of 670 sq km, maximum depth of 104 m, and mean depth of 40 m. An acoustic ('UNI-BOOM') survey along the east-west lines arranged at 2 km intervals and chemical analyses of surface sediment samples every 4 sq km (at 164 sites) were carried out in order to reveal the sedimentation mechanism in a 'deep lake.' Possible sedimentation models are proposed as a result of this study. It is concluded that sedimentation of suspended matter and some elements is well explained by the 'cloud' model. 'Cloud' itself is composed of suspended matter discharged from rivers. At the first stage, river-discharged materials exist near the surface zone of the lake water; they are disseminated universally in the lake making the 'cloud' at the second stage. Distribution of sedimentation rate, sedimentary flux of several elements, and distribution of element contents are the result of settlement of this 'cloud' on the bottom. (Doria-PTT)
W89-04535

2K. Chemical Processes

PARTICIPATION IN THE PRECIPITATION CHEMISTRY NETWORK: PROGRESS REPORT, 1 DECEMBER 1986 TO 31 JULY 1987.
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 7C.
W89-03384

DISTRIBUTION AND FORMATION OF HIGH-FLUORINE GROUNDWATER IN CHINA,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2F.
W89-03405

ORIGIN, DISTRIBUTION, AND EVOLUTION OF SALT-FRESH GROUNDWATER IN NORTH JIANGSU BASIN, CHINA,
Academia Sinica, Nanjing (China). Nanjing Inst. of Geology and Palaeontology.
For primary bibliographic entry see Field 2F.
W89-03406

RELATIONSHIP OF KASCHIN-BECK AND KESHAN DISEASES WITH HYDROGEOCHEMISTRY,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
F. Hongci.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 23-28, August 1988. 4 fig, 8 ref.

Descriptors: *Geochemistry, *Groundwater, *Human diseases, *Geohydrology, *Geochemistry, *China, Chemical properties, Human pathology, Water quality control, Water supply, Alternative water use.

Kaschin/Beck disease and Keshan disease (an endemic myocardial disease) are widespread in China. The close relationship between the diseases and hydrogeochemistry was studied. The diseases occur in areas where groundwater comes either from acidic magmatic rock or from oil-bearing formations; the groundwater in these areas has qualities which distinguish it from normal fresh water. From the common chemical properties of these waters and from foreign environmental medical reports it can be concluded that the principal pathogenic factors are their richness in trace elements and their lowered hardness and calcium content. There are two ways to control Kaschin/Beck and Keshan diseases: One is to improve water quality; the other is to replace pathogenic water sources. (Author's abstract)
W89-03407

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC STUDY OF DISSOLVED ORGANIC MATTER IN NATURAL WATERS,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Knuutinen, L. Virkki, P. Mannila, P. Mikkelson, and J. Paasivirta.
Water Research WATRAG, Vol. 22, No. 8, p 985-990, August 1988. 6 fig, 2 tab, 37 ref.

Descriptors: *Chemical properties, *Organic matter, *Dissolved solids, *High performance liquid chromatography, *Natural waters, *Organic acids, Humic acids, Fulvic acids, Separation techniques, Water analysis.

Surface natural humic water samples free of industrial and domestic inputs were analyzed directly by high-performance liquid chromatography on a TSK gel size-exclusion column system with u.v.

detection at 280 nm. Monomeric and polymeric model compounds and humic and fulvic acid standards were used to determine the concentrations of water soluble high molecular weight organic matter and to estimate humus in the samples. For all samples studied, use of a 0.0002 M NaOH solution was shown to give rise to one sharp peak which was applied for determination of total concentrations of dissolved high molecular weight organic matter in the samples. The retention times of several model compounds used were different and longer than those of high molecular weight matter in humic waters. The data obtained by using this eluent were shown to correlate well with the results obtained by u.v., COD and color determinations. On the other hand, use of distilled deionized water as the eluent resulting in two or more resolved peaks was recommended for separation of humus components and estimation of the concentrations of humic and fulvic acids in natural waters. (Author's abstract)
W89-03435

ADSORPTION OF ZN(II) ONTO HYDROUS ALUMINOSILICATES IN THE PRESENCE OF EDTA,
Delaware Univ., Newark. Dept. of Civil Engineering.
C. P. Huang, E. A. Rhoads, and O. J. Hao.
Water Research WATRAG, Vol. 22, No. 8, p 1001-1009, August 1988. 7 fig, 2 tab, 23 ref. NSF Grant CEE 8104728.

Descriptors: *Zinc, *Adsorption, *Chelating agents, *Silicates, *Clay minerals, *Zeolites, Hydrogen ion concentration, Oxides, Ion exchange, Metal complexes, Silica, Aluminum.

One of the processes which affects the equilibrium concentration of the metals in a particular environment is metal adsorption onto the solid phase. In coastal areas of New Jersey, Delaware, and Maryland, aluminosilicates-rich mineral deposits (glauconite) are abundant. Despite their prevalence in natural systems, limited information is available on metal adsorption by aluminosilicates. In the study, the effects of EDTA on the adsorption of Zn(II) onto various hydrous aluminosilicates was investigated. Two major types of aluminosilicates, amorphous (Zeosyl 100, Zeo 49, Zeolex 23 and Blazer), and crystalline (Zeolite A and Mordenite) and two simple oxides (SiO2 and Al2O3) were studied. Adsorption of EDTA occurred in the acidic pH range and was more pronounced for solids with a low silica to aluminum ratio. The adsorption of EDTA is brought by specific interactions with the surface hydroxyl groups. Solids with a high Si/Al ratio have negatively charged sites, hence little adsorption of EDTA. Depending on the types of solids, the addition of EDTA resulted in a shift of maximum Zn(II) adsorption to the acidic pH range, and reduction of zeta potential. In general, Zn(II) removal in the presence of EDTA was significantly reduced at the alkaline pH range, and slightly enhanced in the acidic pH range. Zn(II) removal may follow an ion exchange process with either free Zn(II) or complex Zn-EDTA, and to some extent, specific adsorption at constant potential sites. (Author's abstract)
W89-03437

THEORY OF FLUORESCENT IRRADIANCE FIELDS IN NATURAL WATERS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
Journal of Geophysical Research JGRDE3, Vol. 93, No. 9, p 10831-10855, September 1988. 4 fig, 20 ref. Office of Naval Research Contract N00014-87-K-0525.

Descriptors: *Spectral analysis, *Irradiation, *Fluorescence, *Mathematical models, Optical properties, Natural waters, Theoretical analysis, Organic matter, Chlorophyll.

The theory of heterochromatic irradiance fields is developed from the fundamental principles of radiative transfer. The irradiance field in natural waters that have fluorescing stratified layers of chlorophyll and other organic material is determined. This is the direct solution of the irradiance field and assumes knowledge of the depth distribution of the inherent optical properties, in particular the spectral absorption and scattering functions. Conversely, these optical properties are determined from in situ irradiance measurements by inverting the direct solution for the irradiance field. This is the inverse solution of the irradiance field. These direct and inverse solutions provide the mathematical framework for optical assays of fluorescing matter in lakes and seas, using measurements of the irradiance field within such media. In particular, the concentrations of the various fluorescing substances within the water are determined from in situ spectral irradiance measurements. (Author's abstract)
W89-03478

DEGRADATION OF SOFTWOOD (14C LIGNIN) LIGNOCELLULOSES AND ITS RELATION TO THE FORMATION OF HUMIC SUBSTANCES IN RIVER AND POND ENVIRONMENTS,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2H.
W89-03559

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART I. THE DENITRIFICATION PROCESS,
Parma Univ. (Italy). Ist. di Ecologia.
For primary bibliographic entry see Field 2I.
W89-03561

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART II. FRACTIONATION AND BIO-AVAILABILITY OF ORGANIC NITROGEN COMPOUNDS,
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
For primary bibliographic entry see Field 2I.
W89-03562

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART III. THE INFLUENCE OF N-APPLICATION ON THE YIELD OF RICE,
Station Biologique de la Tour du Valat, Arles (France).
For primary bibliographic entry see Field 5G.
W89-03563

IONIC CONTENT AS A FACTOR INFLUENCING TURBIDITY IN TWO FLOODPLAIN LAKES AFTER A FLOOD,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-03573

SEDIMENT CHEMISTRY OF LAKES FORMED BY SURFACE-MINING FOR COAL IN THE MIDWESTERN U.S.A.,
Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-03589

FACTORS GOVERNING THE CONCENTRATION OF HYDROGEN PEROXIDE IN STORM INFLOW AIR,
Brookhaven National Lab., Upton, NY.
For primary bibliographic entry see Field 5B.
W89-03604

PHOTOLYSIS OF FE(III)-HYDROXY COMPLEXES AS A SOURCE OF HYDROXYL RADICALS IN ATMOSPHERIC WATERS,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5B.
W89-03605

RADIOACTIVITY IN SPRING WATER AND SURFACE WATER OF SOUTHERN NEVADA,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2F.
W89-03608

RELATIONSHIP OF RADIUM AND RADON WITH GEOLOGICAL FORMATIONS,
RPI International, Inc., Columbia, SC.
J. Michel.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 159-161. 2 fig.

Descriptors: *Geochemistry, *Water chemistry, *Radioisotopes, *Radon, *Aquifers, *Water quality, *Statistical methods, *Geologic formations, Groundwater, Geologic mapping.

Two very detailed studies were conducted to correlate the distribution of Ra-228 with aquifer type and geochemical characteristics in areas with the largest number of Ra-228 measurements, the north-central region and the eastern Peidmont and Coastal Plain geological provinces. Aquifer type and water-quality characteristics were identified for all available Ra-228 measurements. In many cases, statistically significant differences were found for different aquifer types, whereas important trends were identified for limited data sets. Three main aquifer types were found to have high potential for producing groundwater with elevated Ra-228: (1) granite rock aquifers, (2) arkosic sand and sandstone aquifers, and (3) quartoze aquifers with high dissolved solids. Low Ra-228 aquifers were found in all carbonate aquifers, metamorphic rock aquifers and quartoze sand aquifers of the Coastal Plain. These correlations of Ra-228 with geological formations were used to develop maps predicting the nationwide distribution, using the county as the basic mapping unit. A similar approach was used to correlate the distribution of Ra-226 and Rn-222 in groundwater with aquifer characteristics. For these radionuclides, all available data nationwide were plotted onto maps showing the geology of each state, with special emphasis on the use and lithology or geological composition of principal aquifers. Classification schemes were developed to identify the distribution of Ra-226 and Rn-222 by aquifer types. These correlations were used to estimate the distribution of radionuclides in groundwater for areas which lacked actual information. (See also W89-03595) (Miller-PTT)
W89-03610

TRANSFER OF RADON FROM POTABLE WATER INTO HOUSE AIR,
Maine Univ., Orono. Dept. of Physics.
C. T. Hess, M. A. Vietti, E. B. Lachapelle, and J. F. Guillemette.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 164-167. 3 ref. EPA cooperative agreement CR 813554.

Descriptors: *Air pollution sources, *Drinking water, *Radioisotopes, *Radon, *Potable water, *Ventilation, *Risks, Sulfur compounds, Water pollution, Infrared absorption.

To determine the health risk due to radon in water in homes, 40 houses in southern and central Maine were measured for volume, air exchange rate and for radon in water and air. The water and air radon concentrations were recorded at ten minute intervals by a Hewlett Packard 85 computer. Ventilation rate was determined by sulfur hexaflouride tracer samples taken every half hour and measured by infrared absorption. The house volumes ranged from 191,000 to 2,160,000 liters with an average of 562,800 liters. The radon in air concentration ranged from 0.14 to 23.4 picocuries/liter. The radon concentration in water ranged from 194 to 193,000 picocuries/liter with an average of 37,030

picocuries per liter. The transfer coefficient a log-normal distribution and ranged from 0.00020 to 0.0048 with an average of 0.00202 picocuries/liter in air/picocurie/liter in water. The emissivity, which isthe fraction of radon in the water which is released into the air, ranged from 0.02 to 0.97 with an average of 0.486. House ventilation rates were ranged from 0.18 to 1.2 with an average of 0.529 air changes/hr. (See also W89-03595) (Author's abstract)
W89-03611

ROBUST BAYES MODELS OF FISH RESPONSE TO LAKE ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-03686

SIMULATION AND ANALYSIS OF WATERSHED ACIDIFICATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 6A.
W89-03688

SURFACE WATER ACIDIFICATION: THE BIRKENES DATA REVISITED,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03693

MODELLING DISTRIBUTIONS OF AQUATIC CHEMISTRY IN REGIONS IMPACTED BY ACID DEPOSITION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
M. J. Small, P. A. Labieniec, and M. C. Sutton.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 161-172, 11 fig, 21 ref. NSF Grant PYI, ECE-8552772.

Descriptors: *Systems analysis, *Model studies, *Water chemistry, *Acid rain, *Air pollution effects, Rainfall, Limnology, Lakes, Neutralization, Weathering, Survival, Fish, Hydrogen ion concentration, Calibrations, Equilibrium, Water quality, Chemical properties.

A framework is developed for modelling aquatic acidification based on a direct calculation of regional distributions of lake chemistry and their response to acid deposition. The variation of acid neutralizing capacity (ANC) between lakes in a region is represented by a three-parameter lognormal distribution. Shifts in this distribution resulting from changes in acid deposition are predicted by applying empirical weathering models to the moments of the distribution. Resulting changes in the regional distribution of pH are derived from an explicit pH-ANC relationship and estimates of fish viability are made by integrating a species presence-absence relationship over the pH distribution. The equilibrium version of the model presented previously is modified in this paper by incorporating dynamic lags in the regional response to acid deposition. An exponential approach to equilibrium is assumed and equations derived for the dynamic variation of the mean and variance of the regional ANC distribution. An illustrative application is presented for lakes in the southeastern United States. The current model is calibrated in only a preliminary manner, and needs for future calibration-verification and linkage to more mechanistic acidification models are identified. (See also W89-03679) (Author's abstract)
W89-03695

DEVELOPMENT OF A LAKE ACIDIFICATION MODEL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03696

MODELLING STREAM ACIDIFICATION IN UPLAND WALES,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W89-03697

OPTIMAL CONTROL OF SALTWATER INTRUSION: THE YUN LIN BASIN, TAIWAN,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 6A.
W89-03703

APPRAISAL OF WATER RESOURCES OF THE BOULDER AND STILLWATER RIVER BASINS, INCLUDING THE STILLWATER COMPLEX, SOUTH-CENTRAL MONTANA,
Geological Survey, Billings, MT.
For primary bibliographic entry see Field 2F.
W89-03756

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: I. THEORY,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-03810

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: II. NUMERICAL RESULTS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-03811

ALTERNATIVE VIEW ON THE ORIGIN OF CHEMICAL AND ISOTOPIC PATTERNS IN GROUNDWATER FROM THE MILK RIVER AQUIFER, CANADA,
National Water Well Association, Dublin, OH.
For primary bibliographic entry see Field 2F.
W89-03813

ROLE OF TURBIDITY IN THE LIMNOLOGY OF LAKE ALEXANDRINA, RIVER MURRAY, SOUTH AUSTRALIA; COMPARISONS BETWEEN CLEAR AND TURBID PHASES,
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-03854

SEASONAL VARIATIONS IN THE COPPER COMPLEXING CAPACITY OF PORT HACKING,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
For primary bibliographic entry see Field 2L.
W89-03857

LITHIUM AND RUBIDIUM IN THE WAIKATO RIVER, NEW ZEALAND,
Spectrum Resources Ltd., Auckland (New Zealand).
J. E. Bower, and M. H. Timperley.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 201-214, 1988. 6 fig, 3 tab, 25 ref.

Descriptors: *Water chemistry, *Geochemistry, *Lithium, *Rubidium, *Metals, *Alkali metals, *Riparian waters, *New Zealand, Chemical analysis, Igneous rocks, Particulate matter, Weathering, Sediments.

Lithium and rubidium in the Waikato River originate partly from geothermal fluids and partly from weathering of surficial volcanic rocks. The distribution and behavior of these metals in the river system was studied. Total Li concentrations in the river water increased from 0.079 g/cu m at the Lake Taupo outlet to 0.435 g/cu m at Mercer, but the ratios of filterable to particulate metal decreased from 1.82 to 0.322, respectively. The corresponding concentrations for Rb were 0.038 and 0.626 g/cu m, and the ratios were 0.095 and 0.040. Geothermal fluids are the source of about 80% of filterable Li but only 50% of filterable Rb. Weathering of volcanic rocks contributes the remainder of the metals. Approximately 1100 t each of total Li and total Rb flow annually past Lake Aratiatia and more than 99% of these totals flow into the Tasman Sea. About 3 t of Li and 6 t of Rb accumulate each year into reservoir sediment; reservoir macrophytes, which probably turn over each year, could contain up to 0.5 t of Li and 8.4 t of Rb. Within the reservoir sediments and macrophytes, Li, Rb, and K each show different distributions. (Author's abstract)
W89-03865

EFFECT OF ATMOSPHERIC N DEPOSITION ON SURFACE WATER CHEMISTRY AND THE IMPLICATIONS FOR FISHERIES,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 5C.
W89-03876

REVIEW OF SOLID-SOLUTION INTERACTIONS AND IMPLICATIONS FOR THE CONTROL OF TRACE INORGANIC MATERIALS IN WATER TREATMENT.
For primary bibliographic entry see Field 5F.
W89-03890

DROP IMPACT ENERGY: SOIL EXCHANGEABLE SODIUM PERCENTAGE INTERACTIONS IN SEAL FORMATION,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
I. Shainberg, and M. J. Singer.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1449-1452, September-October 1988. 2 fig, 4 tab, 18 ref.

Descriptors: *Soil chemistry, *Cation exchange, *Surface sealing, *Soil compaction, *Sodium, *Impervious soils, *Rainfall impact, Permeability coefficient, Infiltration rate, Gypsum, Surface runoff, Rainfall infiltration, Soil stability, Erosion, Rainfall intensity.

Constant intensity rain (40 mm/hr) with 3.2-mm drops falling from 0.25-, 0.90-, and 2.63-m heights and impact energies of 1.8, 7.6, and 18.6 kJ/cu m, respectively, was used to produce seals on two soils in 55-mm deep by 82-mm diameter acrylic cylinders. Soil exchangeable sodium percentage (ESP) was altered to ESP 0 (Ca-saturated soil), 5, and 10 before rain was applied. Infiltration rate (IR) and hydraulic conductivity (HC) of A horizon material from the Wyman (fine loamy, mixed, thermic Typic Haploxeralfs) and Wyo (fine loamy, mixed, thermic Mollic Haploxeralfs) soils decreased due to formation of soil seals as raindrop energy and ESP increased. The Wyo was more susceptible to sealing than Wyman despite its higher organic C content because of its higher (17 vs. 9%) clay content. Seal formation on Ca-soils (ESP 0) increased gradually with increasing drop impact energy. Soils with ESP 5 and 10 were more susceptible to sealing at low energy rain than were ESP 0 soils. Relative HC and final IR (FIR) decreased with increasing ESP with all rainfall energies and with the no rain treatment on both soils. Aggregate dispersion by raindrop impact and chemical dispersion by sodicity are two complementary processes leading to seal formation. A 5-Mg/ha phosphogypsum treatment applied to the Wyman surface reduced seal formation and maintained HC and FIR near the unrained-on values for the 1.8 and 7.6 kJ/cu m treatments. The 18.6 kJ/cu m raindrop energy produced a seal on the gypsum treated soil with relative HC and FIR more than four times as high as the untreated Wyman. (Author's abstract)
W89-03904

POLYMER AND WATER QUALITY EFFECTS ON FLOCCULATION OF MONTMORILLONITE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. M. Aly, and J. Letey.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1453-1458, September-October 1988. 8 fig, 2 tab, 9 ref.

Descriptors: *Clay minerals, *Water quality, *Polymers, *Flocculation, *Soil conditioners, *Montmorillonite, Soil aggregates, Clays, Soil dispersants, Colloids, Adsorption.

Wyoming Na-montmorillonite (SWy-1) was equilibrated with two synthesized waters, representing Friant-Kern Canal or a typical well water of San Joaquin Valley (electrical conductivity 0.05 and 0.7 dS/m, respectively). Adsorption isotherms and flocculation patterns of the clay with three anionic and one nonionic polyacrylamide polymers and cationic, nonionic and anionic derivatized guar polymers, were observed. Polymer solutions of concentrations 0, 5, 10, 20, 50, and 100 mg/L were prepared and clay was added at a concentration of 1 g/L. The test tubes were shaken and than periodically photographed to record floc formation and settling. Adsorption was in the general order: cationic > nonionic > anionic with the exception of the nonionic guar which was adsorbed about equally as the cationic guar. Adsorption of anionic polymers was greater from well water than canal water, whereas the opposite was true for the cationic polymer. Significant polymer water quality interactions on flocculation were observed. Anionic polymers promoted flocculation in the well water for polymer concentrations > or = 5 mg/L, but enhanced clay suspension stability in canal water. Floc volume increased with increasing cationic and nonionic polymer adsorption, whereas changes in floc volume were insignificant with anionic polymers. An optimal polymer concentration was found with well water. Flocculation with cationic polymer was attributed to charge neutralization, whereas flocculation with anionic polymers was explained by bridging and osmotic attraction. (Author's abstract)
W89-03905

STABLE-ISOTOPE GEOCHEMISTRY OF SALINE NEAR-SURFACE GROUND WATER: EAST-CENTRAL MICHIGAN BASIN,
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
D. T. Long, T. P. Wilson, M. J. Takacs, and D. H. Rezabek.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 10, p 1568-1577, October 1988. 13 fig, 6 tab, 63 ref.

Descriptors: *Geochemistry, *Saline water, *Michigan, *Isotope studies, *Groundwater, Brines, Sulfates, Groundwater recharge, Meteoric water, Aquifers, Salinity, Isotopes, Chemical properties.

Near-surface (< 100 m) groundwater in east-central Michigan basin is characterized by high total dissolved solids (100 to 53,000 mg/l). The source of the salinity and the cause of its distribution are unclear. The hypothesis investigated was that the source of the salinity is brines advecting or diffusing upward into near-surface meteoric water, and the cause of the salinity distribution is the slow flushing of water in the argillaceous sediments by recent meteoric water. Delta O18, delta D, delta C13, delta S34, H3, and selected geochemical variables were studied in the glacial-drift and bedrock aquifers composing the groundwater system. The following isotopic ranges were found: delta O18, 6.93 o/oo to -18.46 o/oo, delta D, -47.3 o/oo to -137.4 o/oo; delta C13, -6.26 o/oo to -20.65 o/oo; and delta S34, +3.56 o/oo to +67.44 o/oo. Delta O18 and delta D plot along the meteoric-water line, and most are extremely light. Delta C13 is skewed to lighter values, and delta S34 becomes heavier with decreasing dissolved SO4 concentration. The results are interpreted to indicate that the saline groundwater is a mix of modern-day, meteoric water and water that recharged the aquifers at a time when the climate was much cooler. The cause of the salinity distribution is the slow flushing of the aquifers by present-day recharge water. The source of the salinity could be the upward diffusion or advection of Michigan basin formation water, but this has not been confirmed. Microbial reduction of SO4 is occurring, affecting the concentrations of SO4 and HCO3 and the values of delta C13 and delta S34. (Author's abstract)
W89-03906

REVIEW OF THE BIOGEOCHEMISTRY OF GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
B. L. Lewis, M. O. Andreae, P. N. Froelich, and R. A. Mortlock.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 107-120, July 1, 1988. 7 fig, 3 tab, 34 ref.

Descriptors: *Trace elements, *Germanium, *Natural waters, *Silicon, *Methylation, Pollutants, Salinity, Estuaries, Rivers, Atomic absorption spectrophotometry, Hydrography, Oceans, Silicates, Water pollution, Geochemistry, Fate of pollutants.

Three germanium species, inorganic germanium (Ge), monomethylgermanium (MMGe) and dimethylgermanium (DMGe) have been identified in natural waters. Ge in solution varies as a coherent pair with silicon, reflecting uptake into and release from the tests of siliceous organisms. MMGe and DMGe display conservative behavior in estuaries and oceans, varying only with salinity. This conservative behavior implies that methylgermanium species are not incorporated into the silicon biogeochemical cycle. The residence time of methyl-Ge in the ocean is estimated to be on the order of a few million years. The production of MMGe, DMGe and trimethylgermanium (TMGe) was observed in an anaerobic sewage digester, suggesting that methyl-Ge in the environment may be produced by microbial biomethylation of Ge during methanogenesis. Algal cultures grown in Ge-enriched media were not observed to produce methylgermanium, nor was Ge methylated by reaction with methylcobalamin, a methylated vitamin B12 derivative. (Author's abstract)
W89-03954

ROLE OF BIOGENIC THIOLS IN THE SOLUBILITY OF SULFIDE MINERALS,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
D. Shea, and W. A. MacCrehan.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 135-141, July 1, 1988. 6 fig, 21 ref.

Descriptors: *Sulfides, *Geochemistry, *Minerals, *Trace metals, *Sulfur compounds, *Sediments, Chromatography, Thermodynamics, Copper, Cadmium, Lead, Interstitial water, Path of pollutants.

Efforts to account for observed trace metal concentrations in anoxic marine waters have had only limited success due in part to the lack of knowledge of the identity and concentration of the organic sulfur compounds that are present. Concentrations of thiols, inorganic sulfur species and trace metals were simultaneously measured in sediment porewaters for the first time. The depth profiles for inorganic sulfur species and trace metals are consistent with those found by others; the thiol profiles have not been reported previously. In addition to the conventional methods for the determination of the inorganic species, methods were developed for the determination of the biogenic thiols and desulfides using an HPLC separation coupled to selective electrochemical detection. The solubility model for sulfide minerals has been expanded to include metal-thiol complexes. One thiol, cysteine, appears to enhance CuS solubility significantly in these porewaters. Thiols seem to have little effect on the solubility of CdS or PbS. Confirmation of these preliminary results awaits more field data and a better understanding of metal-thiol complexes and stability constants. (Stoehr-PTT)
W89-03957

PROCEDURE OF CODING HYDROCHEMICAL DATA FOR CORRESPONDENCE FACTOR ANALYSIS: APPLICATION TO THE CHARACTERIZATION OF GROUNDWATER FLOWS IN MULTI-RESERVOIR SYSTEMS (METHODE D'ADAPTATION DES DONNEES HYDROGEOCHIMIQUES EN ANALYSE DES CORRESPONDANCES: APPLICATION A LA CARACTERISATION DES CIRCULATIONS DANS LES SYSTEMES HYDROGEOLOGIQUES MULTI-RESERVOIRS),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W89-03987

NORTHEASTERN PACIFIC SUBMICROMETER AEROSOL AND RAINWATER COMPOSITION: A MULTIVARIATE ANALYSIS,
Washington Univ., Seattle. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 2B.
W89-03989

CHEMICAL CHARACTERISTICS OF PRECIPITATION IN NH3-AFFECTED AREAS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. A. A. R. Schuurkes, M. M. J. Maenen, and J. G. M. Roelofs.
Atmospheric Environment ATEMBP, Vol. 22, No. 8, p 1689-1698, August 1988. 3 fig, 5 tab, 34 ref.

Descriptors: *Chemistry of precipitation, *Ammonia, *Farm wastes, *Acid rain, Manure, Ammonium, Sulfates, Precipitation, Nitrogen, Rainfall, Chemical composition.

Effects of gaseous ammonia (NH3) on precipitation chemistry were studied in four areas with a significant emission density as a result of animal manure production by intensive stockbreeding activities. In these NH3-affected areas, the quantity of ammonium (NH4(+)) and sulfate (SO4(2-)) in atmospheric precipitation was 1.5-4 times higher than in relatively remote areas, whereas 70-90% of the deposition of nitrogen consisted of NHx compounds. Particularly within a distance of 1 km downwind point-sources of NH3 emission bulk precipitation was less acidic and showed enhanced concentrations of NH4(+) and SO4(2-) than at larger distances. NH3 is the dominant agent which reacts with, and neutralizes, acid compounds in the atmosphere by forming ammonium sulfate (NH4)2SO4. Annual mean volume-weighted concentrations of NH4(+) reached values of 179-369 micromol/l; those of SO4(2-) were 90-145 micromol/l. The highest measured total amount of NHx compounds deposited on an open water surface was 62 kg N/ha/a. In the studied areas, NH4(+) is the dominant form of N in atmospheric precipitation which, together with SO4(2-), falls on and enters the biosphere. (Author's abstract)
W89-03993

GAS-PHASE, CLOUD AND RAIN-WATER MEASUREMENTS OF HYDROGEN PEROXIDE AT A HIGH-ELEVATION SITE,
Tennessee Valley Authority, Muscle Shoals, AL. Air Quality Branch.
K. J. Olszyna, J. F. Meagher, and E. M. Bailey.
Atmospheric Environment ATENBP, Vol. 22, No. 8, p 1699-1706, August 1988. 5 fig, 1 tab, 21 ref.
EPA Agreement 813-934010.

Descriptors: *Air pollution, *Clouds, *Rain, *Hydrogen peroxide, *Chemistry of precipitation, Rainfall, Seasonal variation, Ozone, Temperature, Dewpoint, Condensation, Light intensity, Distribution, Diurnal distribution.

Gas-phase hydrogen peroxide (H2O2) measurements were made at the summit of Whitetop Mountain (1689 m), VA during the summer and fall of 1986. Aqueous-phase (clouds and rain) H2O2 measurements were made at the same location during the spring, summer, and fall of 1986. Measurements indicate a strong seasonal dependence for H2O2, with highest levels in the summer and lower concentrations in spring and fall. The

mean gas-phase H2O2 concentration measured during the summer study was 0.8 ppb while the fall mean was 0.15 ppb. Gas-phase concentrations were strongly correlated with O3, ambient temperature, and dewpoint, and only weakly correlated with light intensity. Hydrogen peroxide exhibited a slight diurnal variation with daytime values exceeding nighttime levels by 26%. Cloud-water H2O2 showed no significant correlation with any of the major ions present in cloud-water. The cloud-water H2O2 levels reported include the highest value (247 microM) thus far reported in the literature. The H2O2 concentrations in cloud samples were usually, but not always, higher than concentrations measured in rain samples. However, samples collected during a simultaneous cloud-rain event yielded higher H2O2 concentrations in the rain, indicating that H2O2 levels aloft exceeded those measured near the ground. (Author's abstract)
W89-03994

DEMETHYLATION OF DIMETHYLSULFONIOPROPIONATE AND PRODUCTION OF THIOLS IN ANOXIC MARINE SEDIMENTS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2L.
W89-04003

DETERMINATION OF POLY-BETA-HYDROXYBUTYRATE AND POLY-BETA-HYDROXYVALERATE IN ACTIVATED SLUDGE BY GAS-LIQUID CHROMATOGRAPHY,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
Y. Comeau, K. J. Hall, and W. K. Oldham.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2325-2327, September 1988. 2 fig, 19 ref.

Descriptors: *Chemical analysis, *Activated sludge process, *Lipids, *Gas liquid chromatography, Sludge, Activated sludge, Polymers, Chromatography, Sample preparation, Chloroform, Reagents, Bacteria, Detection limits, Wastewater treatment, Freeze drying.

Poly-beta-Hydroxybutyrate (PHB) is a common bacterial lipid polymer that is considered to play an important role in phosphate removal in the activated sludge process. Poly-beta-hydroxyvalerate may play a similar role. Gas chromatographic methods for quantifying these compounds require too many purification steps or provide insufficient resolution. An improved method is described for quantifying PHB and PHA in activated sludge that eliminates these problems. The method combines lyophilization of the samples, purification of the chloroform phase by water reextraction, and the use of capillary columns. Activated sludge samples for developing the technique were taken from a pilot plant treating domestic wastewater at the University of British Columbia. With a flame ionization detector, the sensitivity was estimated at 0.00005 g/l. When activated sludge was extracted without lyophilization, the sensitivity of the test was reduced by an order of magnitude. (Doria-PTT)
W89-04007

REMOVAL OF IRON FOR THE SPECTROPHOTOMETRIC DETERMINATION OF HUMIC SUBSTANCES IN FRESH WATERS,
Nagoya Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 7B.
W89-04009

MULTIVARIATE STATISTICAL ANALYSIS OF POTASSIUM AND CHLORIDE REDISTRIBUTION FROM A LINE-SOURCE SPRINKLER EXPERIMENT,
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
W. R. Tillotson, J. W. Biggar, R. H. Shumway, and D. R. Nielsen.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 909-915, July/August 1988. 4 fig, 4 tab, 20 ref.

Descriptors: *Soil chemistry, *Ion transport, *Irrigation effects,tivariate analysis, *Potassium, *Chlorides, *Sprinklers, *Soil water,ribution, Solute transport, Mathematical studies, Statistical analysis,ysis of variance, Profiles, Soil profiles, Soil science, Rainfall.

Water application effects on K and Cl redistribution in a field soil were quantified using a particular multivariate analysis of variance method, profile analysis. A field experiment was conducted using the line-source sprinkler system for the determination of water treatment effects on K and Cl redistribution through comparisons of K and Cl mean redistribution profiles. Samples were analyzed for water soluble K and Cl, and gravimetric water content. A logarithm transformation of the K and Cl data was sufficient for approximate population multivariate normality. Profile analysis identified the water treatment effects of parallelism among the ln K mean redistribution profiles, and symmetry and coincidence among the ln Cl mean redistribution profiles. Identification of specific effects among the mean profiles amounted to the determination of kinematic similarity in K and Cl redistribution. Comparisons of mean profiles corresponding to the depth variables were also analyzed. It is concluded that profile analysis fills a void in the quantification of water treatment effects on solute redistribution not filled by other data analysis procedures. (Author's abstract)
W89-04011

INHIBITION OF HYDROXYAPATITE PRECIPITATION IN THE PRESENCE OF FULVIC, HUMIC, AND TANNIC ACIDS,
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 2G.
W89-04015

FLUORESCENCE SPECTROSCOPY OF HUMIC SUBSTANCES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
T. M. Miano, G. Sposito, and J. P. Martin.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 1016- 1019, July/August 1988. 5 fig, 1 tab, 13 ref.

Descriptors: *Soil chemistry, *Fluorescence, *Spectroscopy, *Humic acids, *Fulvic acids, *Water analysis, Chemical analysis, Hydrogen ion concentration, Aromatic compounds, Soil types, Peat, Loam.

Fluorescence spectroscopy has been underutilized as a method to investigate the nature of humic substances. A study was conducted to obtain fluorescence excitation and emission spectra systematically for a variety of humic and fulvic acids of diverse origin. Solutions containing 50 g/cu m humic or fulvic acid at pH values between 4 and 10 were investigated with excitation, emission, and synchronous-scan excitation modes of fluorescence spectroscopy. The excitation spectra were markedly different for humic vs. fulvic acid and could be used to distinguish unambiguously between the two kinds of humic substance in aqueous solution. The fulvic acid excitation spectra also differed as a function of provenance. The fluorescence emission spectra, although broad, showed maximum-intensity wavelengths that were lower for humic than for fulvic acids, indicating a greater degree of condensed, aromatic character in humic acids. Synchronous-scan excitation spectra of the humic substances showed complex lineshapes that depended sensitively on the type of humic substance as well as on the pH value. These spectra, which are unique for fluorescence processes, may have important potential in resolving condensed aromatic structures in humic and fulvic acids. (Author's abstract)
W89-04017

POTENTIAL FOR BUFFERING OF ACIDIC PRECIPITATION BY MINERAL WEATHERING IN A FORESTED ENTISOL,
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5C.
W89-04020

LASER-ENHANCED IONIZATION AS A SELECTIVE DETECTOR FOR THE LIQUID CHROMATOGRAPHIC DETERMINATION OF ALKYLTINS IN SEDIMENT,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-04025

DETERMINATION OF NONVOLATILE ORGANIC COMPOUNDS IN AQUEOUS ENVIRONMENTAL SAMPLES USING LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W89-04026

SUMMARY OF THE U.S. GEOLOGICAL SURVEY NATIONAL WATER QUALITY ASSESSMENT PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-04041

PRELIMINARY DATA FOR NORTHERN GREAT PLAINS TEST WELL 1, NW 1/4 NE 1/4 SEC. 11, T.55N., R.77W., SHERIDAN COUNTY, WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04055

GENERAL SURFACE AND GROUNDWATER QUALITY IN A COAL-RESOURCE AREA NEAR DURANGO, SOUTHWESTERN COLORADO,
Geological Survey, Grand Junction, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04063

EVALUATION OF SELECTED SURFACE WATER QUALITY STATIONS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04078

RECORDS OF WELLS AND CHEMICAL ANALYSES OF GROUNDWATER IN CAMPBELL COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04089

GEOCHEMICAL STUDIES OF ORGANIC CARBON ASSOCIATED WITH MOUNT ST. HELENS' VOLCANIC ASH,
Geological Survey, Lakewood, CO. Water Resources Div.
W. E. Pereira, and C. E. Rostad.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. In: USGS Water Supply Paper 2262, 1984. p 13-23, 5 fig, 3 tab, 28 ref.

Descriptors: *Volcanoes, *Organic compounds, *Geochemistry, *Sediments, *Volcanic ash, Organic carbon, Gas chromatography-mass spectrometry, Cyclic diterperoids.

A volcanic ash sample obtained after the May 18, 1980, eruption of Mount St. Helens was found to contain significant amounts of organic carbon. Characterization of organic carbon using gas chromatography-mass spectrometry indicated the presence of several classes of compounds, including alkanes, hydroaromatic and aromatic hydrocar-

bons, fatty acids, aromatic acids, aldehydes, phenols, chlorinated aromatics, and tricyclic diterpenoids. The most probable source of these compounds is volatilization of plant and soil organic matter during the eruption, followed by sorption and transport on ash particulates. Evidence is presented to indicate that aromatic hydrocarbons are not products of pyrolysis of organic materials. Tricyclic diterpenoid compounds are probably precursors, intermediates, and end-products in the diagenesis of abietic acid to retene in forest soils. The geochemical significance of these compounds is discussed. (USGS)
W89-04098

AREAL AND TEMPORAL VARIABILITY OF WATER QUALITY OF THE SAN JUAN RIVER DRAINAGE BASIN UPSTREAM FROM SHIPROCK, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
C. L. Goetz, and C. G. Abeyta.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4043, 1987. 89p, 44 fig, 16 tab, 12 ref.

Descriptors: *Water quality, *New Mexico, *Colorado, Time series analysis, Statistical methods, Streams, San Juan River, San Juan County, Shiprock.

Analyses indicate that water quality in the San Juan River drainage basin upstream from Shiprock, New Mexico, is quite variable from station to station. Analyses are based on water quality data from the U.S. Geological Survey WATSTORE files and the New Mexico Environmental Improvement Division's files. In the northeastern part of the basin, most streams are calcium-bicarbonate waters. In the northwestern and southern part of the basin, the streams are calcium-sulfate and sodium-sulfate waters. Geology, climate, and land use and water use affect the water quality. Statistical analysis shows that streamflow, suspended-sediment, dissolved-iron, dissolved-orthophosphate-phosphorus, dissolved-sodium, dissolved-sulfate, and dissolved-manganese concentrations, specific conductance, and pH are highly variable among most stations. Dissolved-radium-226 concentration is the least variable among stations. A trend in one or more water quality constituents for the time period, October 1, 1973, through September 30, 1981, was detected at 15 out of 36 stations tested. The NASQAN stations Animas River at Farmington and San Juan River at Shiprock, New Mexico, record large volumes of flow that represent an integration of the flow from many upstream tributaries. The data collected do not represent what is occurring at specific points upstream in the basin, but do provide accurate information on how water quality is changing over time at the station location. A water quality, streamflow model would be necessary to predict accurately what is occurring simultaneously in the entire basin. (USGS)
W89-04105

USER'S MANUAL FOR ESTIMATION OF DISSOLVED-SOLIDS CONCENTRATIONS AND LOADS IN SURFACE WATER,
Geological Survey, Lakewood, CO. Water Resources Div.
T. D. Liebermann, R. F. Middelburg, and S. A. Irvine.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4124. 51p, 3 tab, 11 ref.

Descriptors: *Computer programs, *Salinity, *Dissolved solids, *Water quality, *Water analysis, Data analysis.

Dissolved solids in surface water are an important indicator of overall water quality. Ordinarily, dissolved-solids concentrations and loads are estimated by indirect methods that are based on periodic chemical analyses. Three computer programs, FLAGIT, DVCOND, and SLOAD, were developed to provide a consistent and accurate method of estimating dissolved-solids concentrations and loads. FLAGIT retrieves daily values of specific conductance and discharge and periodic water quality analyses from the U.S. Geologic Survey's National Water Data Storage and Retrieval System data base, deletes incomplete data, and flags possible data errors. DVCOND fills in missing daily values of specific conductance, when appropriate, by linear interpolation. Using water quality data, SLOAD computes 3 yr moving regressions of dissolved-solids loads as a function of specific conductance and discharge. SLOAD then applies the regression coefficients to the daily values data to estimate daily dissolved-solids loads that are summed by month and by year. Separate regressions are used to estimate the mass fractions of six major ions. The theoretical basis and underlying assumptions of the procedures are presented, with documentation of the programs and their use. (USGS)
W89-04172

DESALINATION OF RECENTLY ACCRETED COASTAL LAND IN THE EASTERN PART OF THE BAY OF BENGAL, BANGLADESH,
Euroconsult, Arnhem (Netherlands).
L. K. Smedema, and A. Jenkins.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 1-11, April 1988. 8 fig, 1 ref.

Descriptors: *Bay of Bengal, *Coastal zone, *Saline soils, *Desalination, Monsoons, Bangladesh, Char soils, Seasonal variation, Capillarity, Leaching, Surface-groundwater relations.

The mechanism of desalinization of the char soils of recently accreted land in the eastern Bay of Bengal area, Bangladesh, is described. The natural groundwater drainage of the land is such that, during the monsoon season, the upper soil layers are readily and rapidly leached naturally. These layers resalinize in the dry season, however, due to the strong capillary characteristics of the find sandy/silty soils. This resalinization will stop only when the upper groundwater layers have become diluted sufficiently, a process that takes decades. (Author's abstract)
W89-04204

DETERMINATION OF CALCIUM IN WATER BY FLOW INJECTION ANALYSIS - INDUCTIVELY COUPLED PLASMA (FIA-ICP) EMISSION SPECTROMETRY,
Hydrological Research Inst., Pretoria (South Africa).
P. L. Kempster, J. F. van Staden, and H. R. van Vliet.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 332, No. 2, p 153-156, 1988. 4 fig, 1 tab, 13 ref.

Descriptors: *Water analysis, *Chemical analysis, *Spectrometry, *Emission spectometry, Flow injection analysis, Inductively coupled plasma, Calcium.

Using an 11 ml centrifugal type spray chamber, a rapid sample introduction rate of 320 injections/hr may be achieved when interfacing flow injection analysis and inductively coupled plasma emission spectrometric techniques. Calcium was determined in water samples with a relative standard deviation of better than 3.5% over the analytical range of 10 to 200 mg/L Ca with a mean recovery of 97%. (Author's abstract)
W89-04287

EVALUATION OF VOLTAMMETRIC TITRATION PROCEDURES FOR THE DETERMINATION OF TRACE METAL COMPLEXATION IN NATURAL WATERS BY USE OF COMPUTER SIMULATION,
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 7B.
W89-04288

DETERMINATION OF NANOMOLAR LEVELS OF NITRITE IN FRESH AND SEA WATER BY CATHODIC STRIPPING VOLTAMMETRY,
Liverpool Univ. (England). Oceanography Lab.
C. Van den Berg, and H. Li.
Analytica Chimica Acta ACACAM, Vol. 212, No. 1-2, p 31-41, September 15, 1988. 6 fig, 14 ref.

Descriptors: *Water analysis, *Chemical analysis, *Cathodic stripping voltammetry, Nitrites, Fresh water, Sea water.

Adsorptive cathodic stripping voltammetry (CSV) is used for the determination of nitrite in natural waters, including sea water. The nitrite is first derivatized by diazotization with sulfanilamide, followed by coupling to 1-naphthylamine to produce an azo dye. This azo dye adsorbs on the mercury drop electrode and its reduction is fully reversible. The concentration of the dye is linearly related to the height of the reduction peak for nitrite concentrations between 0.3 and 200 nM. The optimal concentrations of sulfanilamide and naphthylamine are 2 mM and 0.1 mM, respectively, at a pH of 2.5. After diazotization and coupling, the differential-pulse CSV of the azo dye is done at pH 8.4 with an adsorption potential of -0.3 V. The standard deviation of a determination of 4 nM nitrite is + or - 2% and the limit of detection is 0.3 nM for an adsorption time of 60 s. The linear range can be extended by using shorter adsorption times. The sensitivity in sea water is the same as that in fresh water. The concentration of the dye can also be measured by using anodic stripping voltammetry preceded by adsorptive collection at -0.7 V, but this procedure is less sensitive than CSV. (Author's abstract)
W89-04289

FLUORESCENCE QUENCHING MEASUREMENTS OF COPPER-FULVIC ACID BINDING,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
S. E. Cabaniss, and M. S. Shuman.
Analytical Chemistry ANCHAM, Vol. 60, No. 21, p 2418-2421, November 1, 1988. 3 fig, 18 ref.

Descriptors: *Chemical analysis, *Heavy metals, *Copper, *Trace metals, Trace elements, Fluorescence quenching measurements, Copper-fulvic acid binding, Error analysis.

Current methodologies for calibration and analysis of fluorescence quenching (FQ) data cannot be recommended for studies of Cu binding by dissolved organic matter. Parameter estimates based solely on fluorescence quenching data and a simple 1:1 model are unreliable due to strong covariance among the three fitting parameters and large errors in computed (Cu(2+)) if total copper >> (Cu(2+)). Additional errors arise because the relationship between quenching (Q) and bound Cu concentration (CuL) is not always linear as commonly assumed. Calibrating the fluorescence measurements independently with a technique more directly related to metal concentration (e.g., potentiometry) is recommended. Although fluorescence quenching is fast enough for use in kinetic studies, its error properties compare unfavorably with those of the Cu-PAR spectrophotometric method in most cases. (Author's abstract)
W89-04290

PHOTOCHROMISM-INDUCED PHOTOACOUSTIC SPECTROMETRY FOR THE DETERMINATION OF TRACE MERCURY(II) AS ITS DITHIZONATE IN THE SOLID STATE,
Carleton Univ., Ottawa (Ontario). Dept. of Chemistry.
N. Chen, R. Guo, and E. P.C. Lai.
Analytical Chemistry ANCHAM, Vol. 60, No. 21, p 2435-2439, November 1, 1988. 5 fig, 2 tab, 14 ref.

Descriptors: *Chemical analysis, *Heavy metals, *Trace metals, *Photometry, *Spectrophotometry, *Mercury, Photochromism-induced photoacoustic spectometry, Water analysis.

A new technique, photochromism-induced photoacoustic spectrometry, has been developed for the determination of mercury(II) as mercury(II) dithizonate in the solid state. A special photoacoustic cell was designed for inducing a photochromic reaction in mercury(II) dithizonate and detecting

the resultant photoacoustic signal from its excited state. Interferences from all other metal ions are absent because only mercury(II) dithizonate can exhibit photochromism in the solid state. A linear standard calibration graph for Hg(II) was obtained in the quantity range from 1.5 to 450 pmol. The relative standard deviations determined at 15 and 150 pmol were 6% and 3%, respectively. When the technique is applied to water analysis with dithizone extraction, a detection limit of 3 parts per trillion Hg(II) is easily achievable. (Author's abstract)
W89-04291

PYRITE FORMATION IN ANOXIC ENVIRONMENTS OF THE BALTIC,
Terraqua, Kalundborg (Denmark).
C. Boesen, and D. Postma.
American Journal of Science AFSCAP, Vol. 288, No. 6, p 575-603, June 1988. 12 fig, 3 tab, 73 ref.

Descriptors: *Sediment-water interfaces, *Marine sediments, *Chemical reactions, *Pyrite, *Baltic Sea, Anoxic environments, Iron sulfides, Sedimentation rates, Marine-freshwater interfaces.

In the Baltic, anoxic environments are found in both the Bornholm deep and the Gotland deep that are rich in organic matter and pyrite. The Bornholm deep is characterized by high rates of sedimentation and sulfate reduction. The large amounts of metastable iron sulfides which accumulate are converted to pyrite only over a period of > 500 yr. The reactive iron content of the sediments limits the amount of iron sulfidized, while the supply of sulfate determines whether FeS or FeS2 is dominant. In the Gotland deep, rates of sedimentation and sulfate reduction are lower with very little FeS accumulation in the sediment. Pyrite precipitation appears to occur directly without an intermediate FeS stage. The limiting factor for iron sulfide formation in both environments appears to be available reactive iron. In the Bornholm deep, C/S ratios range from normal marine to slightly higher values. In the Gotland deep, the H2S-containing bottom waters cause a decoupling of the processes of organic matter accumulation and iron sulfide formation. This results in a large scatter of C/S ratios which probably is typical for euxinic environments. In the Gotland deep, freshwater clay below the marine muds is presently being sulfidized by downward diffusion of H2S. This process of sulfidization can be described quantitatively by a diffusion model developed by Berner (1969). (Author's abstract)
W89-04295

DISTRIBUTION AND FORMATION OF HIGH-FLUORINE GROUNDWATER IN CHINA,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
R. Fuhong, and J. Shuqin.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 1, p 3-10, August 1988. 5 fig, 6 tab, 6 ref.

Descriptors: *Fluorine, *Water pollution sources, *Groundwater pollution, *Human diseases, China, Fluorine poisoning, Infiltration, Evaporation, Aeration zone, Soil properties.

In China, high-fluorine groundwater, which contains more than 1.0 mg/L fluorine, is mainly distributed in shallow aquifers of unconsolidated deposits in some arid and semiarid areas, deep aquifers of unconsolidated deposits in semiarid areas, as well as in hot springs of bed rock mountainous areas and aquifers of fluorite-mine areas. Its formation is controlled by regional climate factors, seepage conditions of groundwater, as well as the hydrogeochemical environment. The physicochemical properties of soil mass of the aeration zone play an important role in fluorine concentration in shallow groundwater. In the coastal plain areas, where groundwater is mainly recharged and discharged vertically, and its regime type belongs to the type of infiltration (evaporation), the grain size of soil mass of aeration zone directly influences the amount of fluorine transferred from solid medium into water; and the chemical constituents of the soil mass of aeration zone control the chemical characteristics of the shallow groundwater, consequently influencing the concentration condition of fluorine in water. Fluorine ion in groundwater continuously migrates and concentrates under the comprehensive influence of many factors. High fluorine groundwater, exceeding the sanitary standard (1.0 mg/L) has an obvious zonality in regional distribution in China. Based on current statistics, there are approximately 50 million people who have consumed water which exceeds standards in China. In high fluorine groundwater areas, endemic fluorine poisoning often arises affecting human health seriously. At the end of 1983, 20 million patients were suffering from fluorine poisoning diseases in China. Research on the distribution and formation mechanism of fluorine ion in groundwater has become an important task. (Author's abstract)
W89-04321

WHOLE ECOSYSTEM MANIPULATION: A PRODUCTIVE AVENUE FOR TEST SYSTEM RESEARCH,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 5C.
W89-04351

WET DEPOSITION OF SULFATE IN THE INLAND SEA REGION OF JAPAN,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
S. Fujita, and R. K. Kawaratani.
Journal of Atmospheric Chemistry, Vol. 7, No. 1, p 59-72, July 1988. 6 fig, 2 tab, 30 ref.

Descriptors: *Acid rain, *Coastal areas, *Chemistry of precipitation, *Sulfates, *Japan, *Wet deposition, Seawater, Synoptic analysis, Meteorological data collection, Nitrates.

Precipitation chemistry data derived from a sampling network operated in the Inland Sea model region (June 1984-May 1985) are used as a basis for discussing the wet deposition of sulfate on a regional scale in Japan. Horizontal distribution, seasonal variation, relationship between wet deposition and precipitation amount, sulfate/nitrate ratio, and transport of sulfate from the ocean are discussed. Temporal trends in concentrations of atmospheric sulfur compounds and sulfate wet deposition in the model region are also covered. (Author's abstract)
W89-04365

EFFECT OF BASE ON THE C-13 NMR SPECTRA OF MODEL PHENOLIC ACIDS RELATED TO HUMIC ACIDS AND LIGNINS,
Arizona Univ., Tucson. Dept. of Chemistry.
A. Petsom, and C. Steelink.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 609-620, July 1988. 4 fig, 4 tab, 10 ref.

Descriptors: *Chemical analysis, *Humic acids, *Water analysis, Phenolic acids, Lignins, Fulvic acids, Nuclear magnetic resonance.

Humic acids are naturally-occurring macromolecules which occur ubiquitously in soil and natural waters. These macromolecules contain carboxylic, alcoholic, phenolic, carbonyl, aromatic and aliphatic groups, as well as varying amounts of carbohydrates and amino acids. This study was conducted to determine their chemical structures of humic acids. Addition of base to neutral solutions of a number of model phenolic acids causes shifts in the C-13 NMR absorbance peaks. Some of these shifts appear to be diagnostic for certain structural moieties and functional groups in natural phenolic macromolecules, such as lignin and fulvic acid. (Brock-PTT)
W89-04398

ESTIMATING STREAMWATER CONCENTRATIONS OF ALUMINIUM RELEASED FROM STREAMBEDS DURING 'ACID EPISODES',
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W89-04403

DENITRIFICATION IN COASTAL BAY SEDIMENT: REGIONAL AND SEASONAL VARIATION IN AARHUS BIGHT, DENMARK,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2L.
W89-04423

MICROBIAL RESPONSE TO ORGANIC PARTICLE GENERATION BY SURFACE COAGULATION IN SEAWATER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Biological Oceanography Div.
For primary bibliographic entry see Field 2L.
W89-04426

PHYSICAL AND CHEMICAL CHARACTERISTICS OF BULK PRECIPITATION IN THE RICHARDS BAY AREA, WITH SPECIAL REFERENCE TO LAKE MZINGAZI,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
For primary bibliographic entry see Field 2B.
W89-04438

IRON, MOLYBDENUM AND PHOSPHORUS LIMITATION OF N2 FIXATION MAINTAINS NITROGEN DEFICIENCY OF PLANKTON IN THE GREAT SALT LAKE DRAINAGE (UTAH, USA),
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W89-04489

RELATION OF HYDROGEOLOGIC SETTING TO CHEMICAL CHARACTERISTICS OF SELECTED LAKES AND WETLANDS WITHIN A CLIMATE GRADIENT IN THE NORTH-CENTRAL UNITED STATES,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04490

USE OF REGIONAL LAKE-SULFATE CONCENTRATIONS IN THE EVALUATION OF WATERSHED PROCESSES IN HIGH-ELEVATION PARTS OF THE WESTERN UNITED STATES,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2H.
W89-04491

CHARACTERISTICS OF LAKES IN MOUNTAINOUS AREAS OF THE WESTERN UNITED STATES,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W89-04492

CHARACTERISTICS OF ACIDIC LAKES IN THE EASTERN UNITED STATES,
State Univ. of New York Coll. at Oswego.
For primary bibliographic entry see Field 2H.
W89-04493

VERY IMBALANCED NUTRIENT BUDGET FOR MIRROR LAKE, NEW HAMPSHIRE, U.S.A.,
Institute of Ecosystem Studies, Millbrook, NY.
For primary bibliographic entry see Field 2H.
W89-04495

SEASONAL DYNAMICS OF PHYSICAL AND CHEMICAL PROPERTIES OF A WARM MONOMICTIC RESERVOIR,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.

W89-04496

EXAMPLES OF CHANGES IN WATER CHEMISTRY DURING LAKE ACIDI- AND 'DEACIDIFICATION',
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-04498

DAPHNIA-HOLOPEDIUM RELATIONSHIPS IN CANADIAN SHIELD LAKES RANGING IN ACIDITY,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 2H.
W89-04505

NUTRIENT SUBSIDY IN MONTANE LAKES: FLUVIAL SEDIMENTS VERSUS VOLCANIC ASH,
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 2H.
W89-04511

ROLE OF SEDIMENTATION IN REGULATING MAJOR ION COMPOSITION IN A SOFTWATER, SEEPAGE LAKE IN NORTHERN WISCONSIN,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-04513

EXCRETION OF PHOSPHATE AND AMMONIA FROM MICROCRUSTACEANS, AND ITS VERTICAL AND SEASONAL DISTRIBUTION AT AN OFFSHORE STATION IN LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-04515

RECENT SEDIMENTS IN THE IRON-MEROMICTIC LAKE SKJENNUNGEN,
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W89-04523

MAJOR PATHWAYS INVOLVED IN THE UTILIZATION OF PRIMARY PRODUCTION IN A TEMPERATE EUTROPHIC LAKE,
Carbon 14 Centralen, The International Agency for C14 Determination, 15, Agern Alle, DK-2970 Horsholm, Denmark.
For primary bibliographic entry see Field 2H.
W89-04525

DOSE-EFFECT RELATIONSHIPS BETWEEN PHOSPHORUS CONCENTRATION AND PHYTOPLANKTON BIOMASS IN THE REEUWIJK LAKES (THE NETHERLANDS),
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2H.
W89-04528

ALGAL RESPONSES TO NITROGEN AND PHOSPHORUS ADDITIONS IN FOUR CENTRAL NORTH ISLAND, NEW ZEALAND LAKEWATERS,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 2H.
W89-04539

2L. Estuaries

CAUSES OF WETLAND LOSS IN THE COASTAL CENTRAL GULF OF MEXICO. VOLUME I: EXECUTIVE SUMMARY.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W89-03357

POSTULATED WATER AVAILABILITY GRADIENT IN A COASTAL LANDSCAPE: AN ECOPHYSIOLOGICAL ANALYSIS,
New South Wales Univ., Kensington (Australia). School of Botany.
For primary bibliographic entry see Field 2H.
W89-03391

MICROPHYTOBENTHIC PRODUCTIVITY AND BIOMASS IS SUBLITTORAL SEDIMENTS OF A STRATIFIED BAY, SOUTHEASTERN KATTEGAT,
Goeteborg Univ. (Sweden). Dept. of Marine Botany.
K. Sundback, and B. Jonsson.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol 122, No. 1, p 63-81, October 6, 1988. 8 fig, 3 tab, 61 ref.

Descriptors: *Bays, *Benthic flora, *Productivity, *Biomass, *Bottom sediments, *Stratification, Microorganisms, Kattegat, Primary productivity, Eutrophication, Limiting factors, Light penetration, Nutrients, Phytoplankton, Turbidity, Sediment-water interfaces.

The aims of this investigation were to quantify the sediment-associated microflora in the primary production of an area subjected to eutrophication and to assess the limiting factors. There was considerable potential production, but the actual in-situ production was light-limited at a depth of >5 m. Productivity and biomass did not, however, decrease linearly with depth and some of the highest values were measured at about 15 m, where little of the surface light penetrated. This pattern of distribution along the depth gradient is interpreted as a result of the interaction of light and nutrient conditions, sediment type, and the degree of exposure to water movements. The primary production occurred mainly during May-September and varied depending on depth and sediment type. The annual microphytobenthic production for the whole bay has been estimated as 5-10 g C/square m, which corresponds to 5-10% of the annual phytoplankton production. It is suggested that in an early stage of eutrophication, before an extensive increase in turbidity caused by phytoplankton, the microphytobenthos will benefit from increased nutrient levels. Microphytobenthic production will then have a positive effect on the ecosystem by improving oxygen conditions at the sediment/water interface and by decreasing the release of inorganic nutrients from the sediment. (Author's abstract)
W89-03393

SPECIATION OF PB-210/PO-210 IN AQUATIC SYSTEMS AND THEIR DEPOSITS,
Uppsala Univ. (Sweden). Dept. of Physics.
For primary bibliographic entry see Field 2H.
W89-03400

REMOBILISATION OF ACTINIDES FROM INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY,
UKAEA Atomic Energy Research Establishment, Harwell (England). Environmental and Medical Sciences Div.
For primary bibliographic entry see Field 5B.
W89-03401

NUTRIENT UPTAKE AND RELEASE DURING GROWTH AND DECOMPOSITION OF EELGRASS, ZOSTERA MARINA L., AND ITS EFFECTS ON THE NUTRIENT DYNAMICS OF LAKE GREVELINGEN,
Rusthofstraat 13, 4337 KK Middelburg, The Netherlands.
G. C. Pellikaan, and P. H. Nienhuis.
Aquatic Botany AQBODS, Vol. 30, No. 3, p 189-214, March 1988. 10 fig, 6 tab, 64 ref.

Descriptors: *Nutrient uptake, *Cycling nutrients, *Grasses, *Aquatic plants, *Saline lakes, Estuaries, Marshes, Decomposition, Models, Detritus, Nitrogen, Phosphorus, The Netherlands, Carbon.

Since 1971, when the Grevelingen estuary was turned into a shallow saline lake, meadows of eelgrass have extended rapidly. The role of eelgrass, Zostera marina L., in the uptake and release of nutrients was investigated for 1977 in relation to studies on the nutrient dynamics of Lake Grevelingen. The internal concentrations of carbon, nitrogen and phosphorus in the above-ground parts showed minima for nitrogen (2% of dry weight (DW) and phosphorus (0.15% of DW) in summer. The total year's production of above-ground biomass was calculated as 8510 tons ash-free dry weight (AFDW) for the entire Lake Grevelingen; 93% of eelgrass biomass entered the detritus pool. The decomposition processes of leaching, fragmentation, mineralization, transport and burial are presented in a descriptive model, and input and output data are given. An eelgrass sub-system in shallow water and a gully sub-system in the deeper parts where eelgrass detritus is deposited have been recognized. In autumn, approximately 2% of the eelgrass annual production accumulated near the seawalls. In spring, only 4% of the eelgrass production of the previous year was detected as coarse and fine detritus on the bottom of gullies and sandflats. Eelgrass decomposes slowly and it is likely that, according to the model calculations, after 1 year about one-third of the total eelgrass detritus pool finally accumulates as ultrafine particulate organic matter (POM) on the anoxic gully bottom. From 1971 until 1978, Lake Grevelingen was isolated from the North Sea and rivers. During this period, the dissolved organic carbon (DOC) pool in the water column increased by 2-3 mg/l. Refractory DOC derived from leaching eelgrass detritus contributed 25-40% of this increase. The amounts of nutrients fixed by eelgrass during the growing season, May-August, were estimated at 3829 tons of carbon, 178 tons of nitrogen and 29 tons of phosphorus. These amounts are quite high compared to the results of nutrient balance studies of Lake Grevelingen. It can be concluded that eelgrass is of such importance for the nutrient cycling in Lake Grevelingen that its role must be integrated in the existing nutrient balance model. (Author's abstract)
W89-03461

LEAF PRODUCTION AND EXPORT OF THE SEAGRASS SYRINGODIUM FILIFORME KUTZ. IN INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Inst., Inc., Fort Pierce, FL.
B. Fry, and R. W. Virnstein.
Aquatic Botany AQBODS, Vol. 30, No. 3, p 261-266, March 1988. 1 fig, 1 tab, 7 ref.

Descriptors: *Grasses, *Aquatic plants, *Lagoons, *Primary productivity, *Florida, Food chains, Biomass, Leaves, Plant growth.

Regrowth and in situ-marking techniques were used to estimate leaf production of Syringodium filiforme. in Indian River Lagoon during 1981 and 1982. Productivity varied with season from 0.5 (winter) to 4.0 (summer) g dry weight/sq m/day in 1981 and averaged 1.8 g dry weight/sq m/day during May to August 1982. Seagrass export, estimated by collecting floating leaves over 1 to 2 weeks from field enclosures, averaged 47% of total production in the 1982 summer growing season. Such high rates of export, relative to productivity, characterize the extensive Syringodium meadows in Indian River Lagoon of Florida. (Author's abstract)
W89-03464

INFAUNAL BENTHIC RECOLONIZATION AFTER DREDGING OPERATIONS IN LA CORUNA BAY, NW SPAIN,
Instituto Espanol de Oceanographia, La Coruna (Spain). Centro Costero del La Coruna.
For primary bibliographic entry see Field 6G.
W89-03475

TRACE METALS IN THE EASTERN PART OF THE NORTH SEA. II: FLOWS OF CD, CU, HG, PB AND ZN THROUGH THE COASTAL AREA,
Vrije Univ., Brussels (Belgium). Lab. voor Analytische Chemie.
For primary bibliographic entry see Field 5B.
W89-03476

APPLICATION OF CALCULATION MODELS FOR ESTIMATING PRIMARY PRODUCTIVITY IN TWO TOPICAL MEXICAN COASTAL LAGOONS,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
L. D. Mee.
Revista de Biologia Tropical RBTCAP, Vol. 35, No. 2, p 183-193, November 1987. 6 fig, 1 tab, 24 ref.

Descriptors: *Primary productivity, *Tropical regions, *Lagoons, *Model studies, *Mathematical models, Photosynthesis, Light intensity, Carbon radioisotopes, Mathematical studies.

Data from detailed radiocarbon uptake studies of two turbid and highly productive Mexican tropical coastal lagoons with distinct ecological environments were used to evaluate and adapt calculation models for the integration of total daily C14 productivity (Sigma p). For such environments, the precision of the conventional methodology does not permit reliable estimates of the photosynthetically utilizable light energy term I(k) (introduced by Talling in 1957) from the low light regions of p/I curves. Since the widely used Talling integral was thus not directly applicable, alternative solutions which only require knowledge of the position and height of the subsurface productivity maximum were evaluated. One of these models was found to predict Sigma p to within 10% of planimetric measurements in all cases. Suggestions are given for practical application of this model and for its future development in association with the assimilation number concept. (Author's abstract)
W89-03480

MACROBENTHIC DISTRIBUTION WITHIN THE SEDIMENT ALONG AN ESTUARINE SALINITY GRADIENT: BENTHIC STUDIES OF THE LOWER CHESAPEAKE BAY 8,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
D. M. Dauer, R. M. Ewing, and A. J. Rodi.
Internationale Revue der gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 5, p 529-538, 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Estuaries, *Bottom sediments, *Chesapeake Bay, *Population density, Biomass, Salinity, Vertical distribution, Mollusks, James River, York River, Rapahannock River.

The distribution of the macrobenthic infaunal community within the upper 25 cm of the sediment was studied at 16 stations in the lower Chesapeake Bay. Stations were located from the tidal freshwater to the polyhaline zone of major tributaries (James, York and Rappahannock Rivers) and in the polyhaline portion of the lower bay mainstem. Profiles for total number of individuals, total ash-free dry weight biomass and species encountered with depth were calculated. Except for the deep dwelling bivalve, Macoma balthica, tributary macrobenthic communities had a shallow depth distribution compared to the mainstem sites which were found in generally coarser sediments in the higher salinity region of the estuary. (See W89-03494 thru W89-03496) (Author's abstract)
W89-03493

FURTHER DEVELOPMENTS OF MACROZOOBENTHOS IN LUBECK BAY, FOLLOWING RECOLONISATION IN 1980/81,
Rostock Univ. (German D.R.). Dept. of Biology.
F. Gosselck, F. Doerschel, and T. Doerschel.
Internationale Revue.der gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 5, p 631-638, 1987. 3 fig, 1 tab, 20 ref.

Descriptors: *Benthic fauna, *Coastal waters, *Lubeck Bay, *Baltic Sea, Seasonal variation, Mollusks, Water currents, Species composition, Oxygen deficit, Hydrogen sulfide.

The macrozoobenthos in Lubeck Bay (West Baltic) was investigated from 1982 to 1985. The bottom water layer is characterized by oxygen deficiency or the presence of H2S at depths greater than 20 m in late summer and autumn, when the benthic fauna lacks diversity and consists only of Halicryptus spinulosus, Polydora ciliata and Diastylis rathkei. The influx of oxygen-rich water into the region is followed by rapid colonization by opportunistic species (Capitella capitata, Polydora ciliata) which are joined by predacious species, such as Harmothe sarsi, Halicryptus spinulosus, and Anaitides maculata. Bivalve larvae are carried in by the current. It is assumed that, if the hydrographic conditions remain uniformly favorable, damaged regions will be recolonized after a year by drifting larvae and, for a few species, by adult immigration. (See also W89-03493) (Author's abstract)
W89-03496

NITROGEN CYCLING BETWEEN SEDIMENT AND THE SHALLOW-WATER COLUMN IN THE TRANSITION ZONE OF THE POTOMAC RIVER AND ESTUARY: I. NITRATE AND AMMONIUM FLUXES,
Geological Survey, Reston, VA.
N. S. Simon.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 5, p 483-497, May 1988. 3 fig, 40 ref.

Descriptors: *Sediment-water interfaces, *Nitrogen cycling, *Nitrates, *Cycling nutrients, *Potomac River, *Ammonium, *Estuaries, Rivers, Transition zone, Shallow water, Seasonal variation.

A 3-year study of seasonal variation in water-column and sediment nitrogen species was conducted in the transition zone of the Potomac River 35 m from the Virginia shore at a site with an average water-column depth of approximately 1 m over sandy sediment. A diffusion-controlled sampler was used to collect water samples from the water column, at the interface between the water column and sediment, and at several tens of centimeters into the sediment. Nitrate was the predominant dissolved N species in the water column. The importance of denitrification was inferred by nitrate fluxes which were directed into the sediment from the water column during approximately 75% of the sampling periods and ranged from 0.02 to 0.69 mmol/sq m/day. Flux of nitrate from the sediment into the water column, $>$ or $=$ 0.1 mmol/sq m/day, due possibly to nitrification in surficial sediment, occurred during one spring and two summer sampling periods. Ammonium fluxes were $<$0.1 mmol/sq m/day during 90% of the sampling periods. Of the ammonium fluxes that were $>$0.05 mmol/sq m/day, all were fluxes into the sediment during sampling periods when sediment resuspension occurred, and all were into the water column during periods of calm. The mean value of ammonium flux (0.005 0.05 mmol/sq m/day) from the sandy, shallow-water sediments was two orders of magnitude less than the ammonium fluxes from the deeper, silty channel sediments in the same reach of the river. Diffusive flux calculations suggest that approximately one order of magnitude more nitrate than ammonium is cycled between the shallow-water column and the sandy sediment in the transition zone of the Potomac River. (Author's abstract)
W89-03504

TRACE METALS DISTRIBUTION IN HUANGHE (YELLOW RIVER) ESTUARINE SEDIMENTS,
Shandong Coll. of Oceanography (China). Dept. of Chemistry.
J. Zhang, W. W. Huang, and J. M. Martin.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 5, p 499-516, May 1988. 10 fig, 3 tab, 34 ref.

Descriptors: *Yellow River, *Estuaries, *Sediments, *Trace metals, *Heavy metals, *Suspended sediments, *Huanghe River, *China, Iron, Manganese, Lead, Copper, Zinc, Chromium, Nickel, Aluminum, Rivers, Storms.

Huanghe River and estuarine sediments were analyzed to determine Fe, Mn, Pb, Cu, Zn, Cr, Ni, and Al. The concentrations of these heavy metals are relatively lower than in most of the large rivers/estuaries in the world. The distribution in the Huanghe River estuary is mainly controlled by the natural sedimentary dynamics processes and most likely affected very little by anthropogenic contamination. Despite a substantial sedimentation occurring near the river mouth, a large amount of suspended matter is transported northeastwards and along the coast line in winter. A significant resuspension of surface sediments occurs during storm periods and plays an important role in the particulate heavy metal distribution in the Huanghe River estuary. (Author's abstract)
W89-03505

MANGANESE CYCLING IN COASTAL REGIONS: RESPONSE TO EUTROPHICATION,
Rhode Island Univ., Narragansett. Marine Ecosystems Research Lab.
For primary bibliographic entry see Field 5C.
W89-03506

TRENDS IN NUTRIENT AND OXYGEN CONDITIONS WITHIN THE KATTEGAT: EFFECTS OF LOCAL NUTRIENT SUPPLY,
Goeteborg Univ. (Sweden). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W89-03507

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: 3. EPIFAUNA ON PIER-PILINGS,
Tromsoe Univ. (Norway). Dept. of Marine Biology.
For primary bibliographic entry see Field 5C.
W89-03508

NITROGEN UPTAKE IN THE PHYTOPLANKTON OF OSLOFJORDEN, NORWAY: EFFECTS OF ENVIRONMENTAL AND BIOLOGICAL COVARIATES,
Oslo Univ. (Norway). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-03510

COASTAL AND CATCHMENT BASIN CONTROLS ON ESTUARY MORPHOLOGY OF THE SOUTH-EASTERN CAPE COAST,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
J. S. V. Reddering.
South African Journal of Science, Vol. 84, No. 3, p 154-157, January 1988. 3 fig, 18 ref.

Descriptors: *Estuaries, *Coasts, *Geomorphology, *Inlets, *South Africa, Sand, Waves, Sediments, Tidal prism.

The south-eastern Cape coast can be divided into 4 morphological types: high gradient, hard-rock coast; embayed coast; aeolian dune coast; and low gradient, soft-rock coast. Coastal geomorphology, littoral sand supply, wave influence, tidal prism, tidal inlet configuration and catchment basin lithology all influence the type and shape of an estuary. Several hydrodynamic processes are affected by the type of channel in an estuary, as well as whether its tidal inlet is permanently open. Coastal geomorphology, extent of wave influence, state of tidal inlets, tidal prisms and mud content of the sediment can be used as parameters to formulate a genetically based, physical classification of south-eastern Cape estuaries. This scheme can be expanded to include other Southern African estuaries. (Author's abstract)
W89-03523

PHYSICAL ENVIRONMENTAL FACTORS CONTRIBUTE TO RECURRING HYPOXIA IN THE NEW YORK BIGHT,
National Oceanic and Atmospheric Administration, Rockville, MD. Office of Oceanic and Atmospheric Research.
For primary bibliographic entry see Field 5C.
W89-03525

TIDAL AND RESIDUAL FLOWS IN THE WESTERN DUTCH WADDEN SEA: I. NUMERICAL MODEL RESULTS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
H. Ridderinkhof.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 1, p 1-21, April 1988. 17 fig, 23 ref.

Descriptors: *Tidal basins, *Tidal currents, *Flow pattern, *Wadden Sea, *North Sea, *The Netherlands, *Model studies, *Mathematical models, Inlets, Estuaries.

A two-dimensional numerical model, which includes tidal basins in the western Dutch Wadden Sea and a part of the adjacent North Sea, is used to study tidal and tidally-driven residual flows and elevations. The model is verified by comparing observed and computed water elevations in some stations and transport rates through the tidal inlets. The consequence of topographical and geometrical differences for the terms in the governing equations is discussed by comparing the magnitude of these terms in some characteristic grid points, viz. the open sea, inlet and basin channel, in which all terms are decomposed along and perpendicular to the dominant current direction. Averaging over a tidal period shows that compared to the time-dependent equations an important shift takes place in the relative influence of the different terms, mainly caused by the increased influence of the advective term. The resulting tidally-driven residual flow field is interpreted as a combination of a constant volume transport (1-2% of the tidal transport in the tidal inlets) between connected tidal basins and isolated residual eddies (with velocities of 10-15% of the tidal velocity amplitude and a typical length scale of between 3 and 10 km). Observations confirm that the drop in residual elevations in tidal inlets and the rise in tidal basins are phenomena characteristic of all tidal basins. (Author's abstract)
W89-03530

ASSESSMENT OF BENTHIC PHOSPHORUS REGENERATION IN AN ESTUARINE ECOSYSTEM MODEL,
Nederlands Inst. voor Onderzoek der Zee, Texel.
W. van Raaphorst, P. Ruardij, and A. G. Brinkman.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 1, p 23-36, April 1988. 6 fig, 3 tab, 48 ref, 4 append.

Descriptors: *Estuarine environment, *Cycling nutrients, *Phosphorus regeneration, *Eutrophication, *Sediment-water interfaces, *Wadden Sea, *The Netherlands, *Model studies, *Mathematical models, Phosphates, Mineralization, Benthic environment.

Benthic P regeneration is an important factor in eutrophication processes of shallow water systems. In any ecological modelling approach of such systems an adequate description of the sediment-water interactions is necessary. With this aim a fairly simple concept with a low number of variables and parameters was formulated. The most important parameter regulating the benthic P fluxes is the Damkohler number (Da), which represents the combined effect of the aerobic first order adsorption/desorption rate, the oxygen penetration depth and the apparent diffusion coefficient. For Da <0.3 anaerobic processes dominate P fluxes across the sediment-water interface; for Da >12 chemical transformations in the aerobic layer are the most important. The concept is applied to EMOWAD, an ecological model of the western part of the Dutch Wadden Sea. In the subtidal sediments of this estuary, Da is estimated at 0.4 in summer and 5.8 in winter. For the intertidal areas these numbers are 3.9 and 23, respectively. According to the model, benthic P fluxes are almost absent in winter and reach values of up to 1.75 mmol/sq m/d in summer. Approximately 70% of the organic P compounds reaching the sediments is regenerated within the same year. The model results suggest that organic P accumulated in the sediments during the winter and spring is released into the water column during the summer. Part of the phosphates produced by mineralization is retained temporarily in the sediment due to adsorption to the sediment particles. (Author's abstract)
W89-03531

PHYTOPLANKTON PRIMARY PRODUCTION AND BIOMASS IN THE WESTERN WADDEN SEA (THE NETHERLANDS): A COMPARISON WITH AN ECOSYSTEM MODEL,
Nederlands Inst. voor Onderzoek der Zee, Texel.
M. J. W. Veldhuis, F. Colijn, L. A. H. Venekamp, and L. Villerius.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 1, p 37-49, April 1988. 11 fig, 2 tab, 31 ref.

Descriptors: *Phytoplankton, *Algae, *Primary productivity, *Biomass, *Wadden Sea, *The Netherlands, Model studies, Simulation, Diatoms, Flagellates, Seasonal variation, Nutrients, Silicon, Phosphorus, Nitrogen, Estuaries, North Sea.

Dissolved nutrient concentrations (Si, P, N), algal biomass (separated into diatoms and microflagellates), and total primary production were determined in 1986 during 7 cruises in both the inner and outer parts of the estuary of the western Wadden Sea. The biomass data, obtained after converting cell biovolume and cell counts into carbon, were compared with those simulated by a two-dimensional multitrophic ecosystem model. The general pattern of the succession of algal species was the same for all compartments: a bloom of diatoms in early spring followed by one of microflagellates, predominantly the colonial alga Phaeocystis pouchetii. Throughout the year the biomass of the two algal groups differed between inner and outer compartments of the estuary. In spring the carbon biomass of the microflagellates in the compartments bordering on the North Sea exceeded that of the inner compartments by a factor of 2. The reverse was found for the diatoms in summer. A reasonable fit between the field data and simulated data was only obtained in spring; large differences were found for the summer period. During that period an extensive diatom population characterized by a low primary production was observed, which did not correspond with the model simulation. Possible factors causing the differences between observed and simulated data, e.g. nutrient regeneration, were analyzed. (Author's abstract)
W89-03532

TEMPORAL AND LATERAL FLUCTUATIONS IN PRODUCTION AND BIOMASS OF BACTERIOPLANKTON IN THE WESTERN DUTCH WADDEN SEA,
Nederlands Inst. voor Onderzoek der Zee, Texel.
F. C. van Duyl, and A. J. Kop.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 1, p 51-68, April 1988. 13 fig, 1 tab, 47 ref.

Descriptors: *Marine bacteria, *Bacterioplankton, *Biomass, *Aquatic productivity, *Wadden Sea, *The Netherlands, Estuaries, *Seasonal variation, Model studies, Simulation, North Sea, Nutrients.

To contribute to the validation of a recently developed ecosystem model of the western Wadden Sea, data on bacterial biomass and production were acquired. Seven field stations, spread over the two main basins of the estuarine system, were sampled monthly in 1986. Between these basins significant differences were found in counts, biovolume, biomass and production of bacteria (measured by the tritiated thymidine method) with consistently higher mean values of bacterial variables in the Vlie basin. Bacterial production rates of 2-175 mg C/cu m/d were obtained for the Vlie basin, with an annual production of 10-11 g C/cu m, while the production in the Marsdiep basin did not exceed 45 mg C/cu m/d, with an annual production of 3 g C/cu m. Bacterial biomass varied over the year from 2-140 mg C/cu m in the study area, with a mean biomass of 39 mg C/cu m in the Vlie basin and 23 mg C/cu m in the Marsdiep basin. Blooms of bacteria occurred in May and July-August. Spatial and temporal fluctuations in bacterial variables are discussed, taking into account different environmental factors and the availability of food for bacteria in relation to transport and exchange of water masses between the two basins and the North Sea. Results are compared with the results as simulated by the ecosystem model. (Author's abstract)
W89-03533

DISTRIBUTION AND ABUNDANCE OF THE ZOOPLANKTON OF THE EMS ESTUARY (NORTH SEA),
Nederlands Inst. voor Onderzoek der Zee, Texel.
J. W. Baretta, and J. F. P. Malschaert.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 1, p 69-81, April 1988. 1 fig, 4 tab, 32 ref.

Descriptors: *Zooplankton, *Estuaries, *The Netherlands, *West Germany, *Population density, Wadden Sea, Salinity, Ems estuary, North Sea.

From 1974-77 a study was made of the abundance and distribution of the zooplankton species of the Ems estuary (The Netherlands and the Federal Republic of Germany), an area of about 500 sq km with extensive tidal flats. The most important component of the zooplankton consisted of holoplanktonic calanoid copepods with, during the summer, a significant contribution of meroplankton, mainly consisting of polychaete and cirripede larvae. Zooplankton abundance showed a marked seasonality, with a pronounced spring peak and a smaller late summer/autumn peak. In the low salinity area the spring bloom was dominated by Eurytemora affinis, which persisted in the salinities below S=5 upriver during the whole year. In the polyhaline area Acartia bifilosa was the main component of the spring bloom. The late summer maximum from August to October was dominated by A. tonsa in the meso- and polyhaline area and by A. discaudata and Centropages hamatus in the euhaline part of the estuary bordering on the Wadden Sea proper. The number of abundant (>1000 ind/cu m) species increased from the inner, fresher part of the estuary towards the Wadden Sea but, except for April, average zooplankton density in salinities <18 was similar (2768 ind/cu m) to the density in salinities >18 (2817 ind/cu m). The distribution patterns show that there are only a few autochthonous species and that the majority of species is allochthonous and penetrates more or less deeply into the estuary from the Wadden Sea and North Sea, varying with species and season. (Author's abstract)
W89-03534

FLUX OF PARTICULATE INORGANIC MATTER THROUGH THE NIGER RIVER INTO THE ATLANTIC OCEAN,
Lagos Univ. Abeokuta Campus (Nigeria). Coll. of Science and Technology.
For primary bibliographic entry see Field 2E.
W89-03535

SUSPENDED MATTER AND BOTTOM DEPOSITS IN THE MARONI ESTUARINE SYSTEM (FRENCH GUIANA),
Institut de Geologie du Bassin d'Aquitaine, Talence (France).
J. M. Jouanneau, and M. Pujos.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 2, p 99-108, July 1988. 9 fig, 5 tab, 38 ref.

Descriptors: *Estuaries, *Sedimentation, *Bottom Sediments, Maroni River, French Guiana, Seasonal variation, Suspended sediments.

Field studies on the Maroni river were conducted during one rainy season and one dry season. The sand of the Maroni fluvio-estuarine system are

subject to seasonal variations. During the dry season the sands were distributed in 2 groups on either side of the Ile aux Pigeons, whereas during the rainy season, greater homogeneity was noted throughout the estuary. The sands gave evidence of a lengthy history including marine, continental and finally fluviatile stages. They play a part in sedimentation on the inner continental shelf. Fine sediments had uniform characteristics throughout the year. Mineralogic and elemental composition in the vicinity of Ile Portal indicated that they were different on either side of a limit separating the fluviatile and estuarine zones. Sediment groups were respectively autochtonal (upstream) and allochtonal (downstream), while the characteristics of the clay assemblage and elemental composition in the latter zone are evidence of an Amazon River origin. Their patterns showed evidence of a local stock that is quickly diluted by the mass of sediments derived from the Amazon River, the predominant source for the region. (Author's abstract)
W89-03536

LONG-TERM SOFT-BOTTOM FAUNAL CHANGES IN THREE SHALLOW FJORDS, WEST SWEDEN,
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
A. B. Josefson, and R. Rosenberg.
Netherlands Journal of Sea Research NJSRBA, Vol. 22, No. 2, p 149-159, July 1988. 3 fig, 7 tab, 27 ref. Swedish Environment Protection Board, Contract 6339246-0.

Descriptors: *Fjords, *Benthic fauna, *Invertebrates, *Eutrophication, *Species composition, Species diversity, Biomass, Bottom water, Hypoxia, Sweden.

Three West Sweden fjords were investigated at the same 14 stations in 1976 and 1986; 8 of these had been investigated in the 1920's. The stations are situated at 7 to 27 m water depths in protected areas without any significant local pollution input, but now with organically enriched sediments. Comparisons of benthic fauna between 1976 and 1986 showed the following significant reductions: in total mean abundance and biomass (excluding some large and rare species); in abundance and biomass of molluscs; in abundance of suspension feeders and carnivores. Similarity indices gave significant differences between 1976 and 1986, and between the 1920's and both 1976 and 1986. The greatest changes had occurred in the 2 fjords with the most restricted water circulation. Although these faunal changes may be attributed to several factors, recently increased periods of hypoxia in the bottom water, which could be a result of large-scale eutrophication, are suggested as the main impact on the benthos. (Author's abstract)
W89-03537

EXPERIMENTAL MEASUREMENT OF RESOURCE COMPETITION BETWEEN PLANKTONIC MICROALGAE AND MACROALGAE (SEAWEEDS) IN MESOCOSMS SIMULATING THE SAN FRANCISCO BAY-ESTUARY, CALIFORNIA,
CH2M Hill, Emeryville, CA.
For primary bibliographic entry see Field 5C.
W89-03567

SHATT AL-ARAB RIVER: A NUTRIENT SALT AND ORGANIC MATTER SOURCE TO THE ARABIAN GULF,
Basrah Univ. (Iraq). Dept. of Environmental Marine Chemistry.
J. K. Abaychi, S. A. Darmoian, and A. A. Z. DouAbul.
Hydrobiologia HYDRB8, Vol. 166, No. 3, p 217-224, September 30, 1988. 3 fig, 3 tab, 24 ref.

Descriptors: *Estuarine environment, *Nutrients, *Organic matter, Sediments, *Persian Gulf, Phosphorus, Nitrates, Nitrites, Kjeldahl process, Dusts.

The distribution of dissolved reactive phosphate, nitrate, and nitrite in the waters as well as total organic carbon, total phosphorus, and Kjeldahl nitrogen in the sediments of the Shatt al-Arab Estuary and the northwestern Arabian Gulf were studied from November 1979 to April 1980. The Shatt al-Arab waters contain 0.18 to 0.70 microg-at/l phosphate P, 26.12 to 52.39 microg-at/l nitrate N, and 0.53 to 0.70 microg-at/l nitrite N, indicating that this river should be considered a source of nutrients to the Arabian Gulf. It was concluded that most of the nitrate is supplied in dissolved form, while an appreciable amount of phosphate is adsorbed to fine suspended particles and released at higher salinities. Total organic carbon in surficial sediment was found to vary between 0.14% and 0.96%. These rather low values are attributed to dilution by dust fallout, which is a major source of sediments in this area. (Author's abstract)
W89-03593

SYSTEM APPROACH TO ANALYSIS OF WATER QUALITY DUE TO TRANSPORT MECHANISMS IN THE WATER ENVIRONMENT,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 6A.
W89-03690

NARRAGANSETT BAY: ISSUES, RESOURCES, STATUS AND MANAGEMENT.
National Oceanic and Atmospheric Administration, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-175757. Price codes: A06 in paper copy, A01 in microfiche. Proceedings of a Seminar held January 28, 1985, Washington, DC. NOAA Estuary-of-the-Month Seminar Series, No. 1, August 1987. 171p.

Descriptors: *Rhode Island, *Water pollution effects, *Narragansett Bay, *Water pollution sources, *Ecological effects, Conferences, Economic aspects, Social aspects, Management planning.

Papers presented at a seminar on Narragansett Bay on January 28, 1985 have the objective of bringing to the public attention the important research and management issues in the Bay. The many issues concerning the health and value of the Bay are considered with subjects ranging from waste crankcase oil disposal to sociological concerns. First an overview is given then explanations of Bay economics, pollution inputs, circulation dynamics, and management issues. (See W89-03724 thru W89-03726) (Author's abstract)
W89-03723

BAY AND THE ECONOMY,
N. Rorholm.
IN: Narragansett Bay: Issues, Resources, Status and Management. Proceedings of a Seminar held January 28, 1985, Washington, DC. NOAA Estuary-of-the-Month Seminar Series, No. 1, August 1987. p 17-29.

Descriptors: *Rhode Island, *Economic aspects, *Narragansett Bay, *Waste disposal, Recreation, Transportation, Marine resources, Navigation.

The impact of Narragansett Bay on the economy of Rhode Island was examined. For the Narragansett Bay quahog resource, the harvest may be somewhere between 16 and 18 million dollars. The Navy has had a powerful long-term influence on the economy of Narragansett Bay, with revenues dropping from about 215,000 to 98,000 dollars. Marine transportation annual revenues have increased little due primarily to freight and the carrying of freight. Commercial fishing has increased about 500% since 1967. The marine industry is a composite of shipbuilding, oil and gas service companies, instrumentation companies and boat gear suppliers. As long as people dump in the Bay, then that is a service the Bay is performing. It is measured here as an opportunity cost. It would have taken about 300 million dollars to prevent pollution from passing through Field's Point Sewage Plant. This expense has increased over time. Narragansett Bay therefore accounts for 15% of the total personal income in the State of Rhode Island. The gross state product is about $14 billion with personal income around $11 billion. This adds up in direct numbers to $1.3 billion from the bay. (See also W89-03723) (Lantz-PTT)
W89-03724

CIRCULATION DYNAMICS,
M. Spaulding.
IN: Narragansett Bay: Issues, Resources, Status and Management. Proceedings of a Seminar held January 28, 1985, Washington, DC. NOAA Estuary-of-the-Month Seminar Series, No. 1, August 1987. p 71-146, 50 fig, 16 ref.

Descriptors: *Water circulation, *Tides, *Path of pollutants, *Narragansett Bay, *Rhode Island, Waves, Fluid dynamics, Tidal hydraulics, Wind, Providence River, Seekonk River.

The three major components of circulation dynamics are long period wave forcing, wind forcing, and density/river runoff forcing. Long period waves (tide and seiching) are primarily standing wave systems with surface elevation and tidal current out of phase by 80 degrees. M2(semidiurnal tidal component) forcing predominates with a mean tidal range of 1.1m at the bay mouth and amplifies a factor of 1.3 at the head due to bay geometry - phase lag of 20 minutes. Interaction of M2, and M4 and M6 (M2 harmonics) tidal constituents and 5 hr longitudinal seiching frequency of bay leads to distinct double peak flood currents. Factor of two differential in depth between the west (shallow) and east (deep) passage leads to stronger tidal currents and larger transport in the east passage. Since the bay time response of 10 hrs is short compared to the predominate 4-10 day meteorological forcing the bay is in quasi-steady state. Wind induced flows are strongly impacted by the presence of the tide and the resulting enhanced bottom friction. The directionality of wind forcing combined with the differential depths in the east and west passage results in substantial inter-passage transport with magnitudes 15-30% of tidal transport for typical wind stress levels. Non-local wind forcing at 2-10 day periods may be significant in the lower bay. Wind induced response is a strong function of location, extending from weak correlation in the upper bay to strongly correlated in the lower bay. With respect to density/river, runoff the bay is well mixed in the lower reaches, partially mixed in the mid-section and stratified in the Providence and Seekonk Rivers. Dredged channel in the upper bay strongly impacts residual flow field. Pollutant transport dynamics involve the following components: (1) Narragansett Bay has a flushing time of 10-40 days (mean value - 26 days) depending on the freshwater runoff. Providence River - 3 to 10 days; (2) The principal transport mechanisms in Providence River are horizontal advection and diffusion. Lateral diffusion is most important where the dredged channel represents only a small portion of the cross sectional area; (3) All pollutants show high values in Providence River in the vicinity of waste discharges and decrease to near background at mid-bay. Dilution rates of 0.5/day are typical. Storm induced pollutant loads modify this character for periods, 5-7 days. (See W89-03723) (Lantz-PTT)
W89-03726

RELATIVE SELECTIVITY OF FIVE COASTAL MARSH SAMPLING GEARS,
Louisiana Cooperative Fish and Wildlife Research Unit., Baton Rouge.
For primary bibliographic entry see Field 7B.
W89-03851

ORGANIC CARBON AND NITROGEN FLOW FROM MARINE CYANOBACTERIA TO SEMIAQUATIC INSECT FOOD WEBS,
Texas Univ., Port Aransas. Marine Science Inst.
W. M. Pulich, and R. S. Scalan.
Contributions in Marine Science, Vol. 30, p 27-37, December 1987. 1 fig, 3 tab, 26 ref.

Descriptors: *Cyanophyta, *Marine algae, *Food chains, *Insects, *Tidal flats, Organic carbon, Nitrogen, Carbon cycle, Nitrogen cycle.

On coastal wind-tidal flats of South Texas, stable carbon isotopic composition of resident semiaquatic insects reflects the isotopic signature of cyanobacterial mats, the dominant primary producers. As evidenced by the abundance of insect populations, the transfer of marine cyanobacterial biomass to insect food webs is a major pathway of carbon flow in this intertidal environment. Three distinct plant nitrogen sources are delineated from the nitrogen isotope data set: blue-green algae, upland plants, and plants of a freshwater playa area; however, additional nitrogen measurements are necessary to demonstrate trophic relationships between insects. (Author's abstract)
W89-03852

VARIABILITY IN THE DISTRIBUTION OF LATE-STAGE OYSTER LARVAE IN THE CALCASIEU ESTUARY,
McNeese State Univ., Lake Charles, LA. Dept. of Biological and Environmental Sciences.
For primary bibliographic entry see Field 4C.
W89-03853

SEASONAL VARIATIONS IN THE COPPER COMPLEXING CAPACITY OF PORT HACKING,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
D. J. Mackey, and R. Szymczak.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 39, No. 2, p 125-132, 1988. 5 fig, 33 ref.

Descriptors: *Copper, *Metal complexes, *Metals, *Estuaries, Seasonal variation, Coastal waters, Eutrophication, Metals, Phytoplankton, Australia.

The copper complexing capacity (CuCC) of waters at the entrance to Port Hacking estuary, Australia, was monitored approximately daily from February to November 1984. Biological and hydrological parameters collected from this area since 1942 provide a wealth of historical data to aid in the interpretation of the results. From May to August, the CuCC values averaged about 5 nM, with occasional high values (up to 17 nM) attributable to terrestrial runoff following heavy rainstorms. In mid-October, CuCC values up to 56 nM were attributable to a phytoplankton bloom that resulted from the intrusion of nutrient-rich slope waters onto the continental shelf. These intrusions of slope water seem to be driven onto the continental shelf by the approach of the East Australian Current and its associated eddy field. The approach of an eddy coincided with a secondary maximum in the CuCC (30 nM) that occurred in mid-April. The CuCC of Port Hacking is dominated by processes originating outside the estuary; Port Hacking cannot therefore be a significant source of organic ligands to coastal waters. (Author's abstract)
W89-03857

POST-1847 CHANGES IN THE AVON-HEATHCOTE ESTUARY, CHRISTCHURCH: A STUDY OF THE EFFECT OF URBAN DEVELOPMENT AROUND A TIDAL ESTUARY,
Christchurch City Engineer's Dept. (New Zealand).
For primary bibliographic entry see Field 4C.
W89-03860

'FURKERT-HEATH' RELATIONSHIP FOR TIDAL INLET STABILITY REVIEWED,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
T. M. Hume, and C. E. Herdendorf.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 1, p 129-134, 1988. 2 fig, 1 tab, 27 ref.

Descriptors: *Model studies, *New Zealand, *Inlets, *Stability analysis, *Tidal effects, Mathematical models, Reviews, Channel erosion, Error analysis.

The 'Furkert-Heath' relationship is a commonly used method of assessing the stability of New Zealand inlets. However, the equation published by Heath in 1975 was incorrectly calculated which has led to misinterpretation of data in some cases. Recalculation resulted in a new linear relation between the inlet gorge cross-sectional area A and tidal prism omega. Misuses of the 'Furkert-Heath' equation are identified including: extrapolating predictions beyond the data field; neglecting errors inherent in measurement of A and omega; method of characterizing sedimentation regime; neglecting confidence limits of data; using A-omega relationships as the sole indicator of inlet stability; and applying the relationship to inlets other than barrier-enclosed inlets. (Author's abstract)
W89-03861

POVERTY BAY, NEW ZEALAND: A CASE OF COASTAL ACCRETION 1886-1975,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. K. Smith.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 1, p 135-141, 1988. 4 fig, 2 tab, 9 ref.

Descriptors: *Accretion, *Deposition, *Beach profiles, *Bays, *New Zealand, *Sedimentation, History, Geomorphology, Surveys, Sediment yield, Beaches, Port facilities, Diversion, Erosion.

Survey and aerial photograph measurements reveal that increased sediment yield has resulted in the deposition of 3,970,000 cu m of material around the bay and up to 500 m of progradation in the southwest of Poverty Bay, New Zealand, since the 1880s. Initially, port development enhanced sedimentation on the north-eastern side of the Bay, but later sand mining and river diversion caused the newly accreted deposit to be eroded. The eastern end of the beach now appears to be in a state of quasi-equilibrium. Stopbanking the Waipaoa River has increased sedimentation in the south-west where the rate of fluvial supply exceeds the capacity of marine transport processes. Increased sediment yield associated with land clearance has caused a 25% increase in the volume of material annually deposited on Waikanae and Muriwai beaches. (Author's abstract)
W89-03862

TRAPPED SEA WATER IN LAKE HAKAPOUA, NEW ZEALAND,
Department of Scientific and Industrial Research, Wellington (New Zealand). Div. of Marine and Freshwater Science.
For primary bibliographic entry see Field 2H.
W89-03869

CONTRASTING BEHAVIOUR OF DISSOLVED AND PARTICULATE NICKEL AND ZINC IN A POLLUTED ESTUARY,
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5B.
W89-03936

COMPARISON OF SALT MARSH HUMIC ACID WITH HUMIC-LIKE SUBSTANCES FROM THE INDIGENOUS PLANT SPECIES SPARTINA ALTERNIFLORA (LOISEL),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
Z. Filip, J. J. Alberts, M. V. Cheshire, B. A. Goodman, and J. R. Bacon.
Science of the Total Environment STENDL, Vol. 71, No. 2, p 157-172, May 1988. 6 fig, 4 tab, 38 ref.

Descriptors: *Microbial degradation, *Organic matter, *Spartina *Salt marshes, *Humic acids, *Marine sediments, *Detritus, Degradation products, Degradation, Chemical analysis, Carbon, Hydrogen, Nitrogen, Oxygen, Mass spectrometry, Vanadium, Copper, Heavy metals, Chlorophyll, Infrared spectroscopy.

Substances resembling humic acids were extracted from fresh plant material (Spartina alterniflora) and from dead plant debris. Their elemental composition, spectral characteristics in the UV, visible and IR regions, and electron spin resonance were compared with those of humic acid from mud in which the plants were growing. The results show the plant humic substances to consist of a higher portion of aliphatic compounds in their complex structures than that from mud. However, the overall similarities between the extracted materials from the different sources indicate that S. alterniflora makes a direct contribution to the humic substances in the salt marsh ecosystems. (Author's abstract)
W89-03937

DEMETHYLATION OF DIMETHYLSULFONIOPROPIONATE AND PRODUCTION OF THIOLS IN ANOXIC MARINE SEDIMENTS,
Georgia Univ., Sapelo Island. Marine Inst.
R. P. Kiene, and B. F. Taylor.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2208-2212, September 1988. 4 fig, 30 ref. NSF Grant OCE-8516020.

Descriptors: *Biochemical tests, *Organic compounds, *Water chemistry, Marine sediments, Anaerobic conditions, Sulfur compounds, Microbiological studies, Sulfur cycle, Chemical reactions, Coastal waters, Algae, Marine algae, Aquatic plants, Aquatic life, Enzymes, Degradation, Biodegradation, Sediments, Saline water.

Dimethylsulfoniopropionate (DMSP) is a natural product of algae and aquatic plants, particularly those from saline environments. Whether DMSP could serve as a precursor of thiols in anoxic coastal marine sediments was investigated. The addition of 10 or 60 microM DMSP to anoxic sediment slurries caused the concentrations of 3-mercaptopropionate (3-MPA) and methanethiol (MSH) to increase. Antibiotics prevented the appearance of these thiols, indicating biological formation. Dimethyl sulfide (DMS) and acrylate also accumulated after the addition of DMSP, but these compounds were rapidly metabolized by microbes and did not reach high levels. Acrylate and DMS were probably generated by the enzymatic cleavage of DMSP. MSH arose from the microbial metabolism of DMS, since the direct addition of DMS greatly increased MSH production. Additions of 3-methiolpropionate gave rise to 3-MPA at rates similar to those with DMSP, suggesting that sequential demethylation of DMSP leads to 3-MPA formation. Only small amounts of MSH were liberated from 3-methiolpropionate, indicating that demethiolation was not a major transformation for 3-methiolpropionate. It is concluded that DMSP was degraded in anoxic sediments by two different pathways. One involved the well-known enzymatic cleavage to acrylate and DMS, with DMS subsequently serving as a precursor of MSH. In the other pathway, successive demethylations of the sulfur atom proceeded via 3-methiolpropionate to 3-MPA. (Author's abstract)
W89-04003

AVAILABILITY OF STREAMFLOW DATA FOR THE MOBILE RIVER AND ITS DISTRIBUTARIES INCLUDING THE LOWER ALABAMA RIVER AND LOWER TOMBIGBEE RIVER,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04147

DESALINATION OF RECENTLY ACCRETED COASTAL LAND IN THE EASTERN PART OF THE BAY OF BENGAL, BANGLADESH,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 2K.
W89-04204

PYRITE FORMATION IN ANOXIC ENVIRONMENTS OF THE BALTIC,
Terraqua, Kalundborg (Denmark).
For primary bibliographic entry see Field 2K.
W89-04295

DIVERGENCE AND ENTRAINMENT IN A RIVER EFFLUENT: THE HEARTBREAK MODEL,
Kyoto Univ. (Japan). Dept. of Fisheries.
H. Kawai.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 44, No. 1, p 17-32, February 1988. 21 fig, 1 tab, 8 ref.

Descriptors: *Mixing, *Model studies, *Mathematical models, *Hydrologic models, *Rivers, *Entrainment, *Shinano River, *Japan, *Freshwater-seawater interfaces, *River mouth, River effluent, Heartbreak Model, Divergence.

The results of experiments of tracking drifters and detailed observations made in the Shinano River effluent in October-November 1970 and May 1971 are presented. A new entrainment constant, which is really the nondimensional flow normal to an interface between effluent and seawater, shows a relation that this normal flow is the sum of the nondimensional longitudinal and lateral divergences of the effluent with arbitrarily shaped streamlines. The natural coordinate system is used under a quasi-steady state assumption. Using field data and stated relationships the Heartbreak Model with intermittently pinched-off auricles for the effluent is proposed. Considerable lateral divergence in the Shinano River effluent is found within 500m of the river mouth. This causes a loss of available potential energy associated with a steep upslope of the interface downstream and the inward flow normal to the interface. It is also found that the effluent exhibits an asymmetric heart-shaped distribution. The pit near the central axis about 1 km from the mouth is due to the inward normal flow associated with the dominant lateral divergence; enlargement and detachment of auricles on both sides of the pit are due to the outward normal flow associated with the dominant longitudinal convergence. (Author's abstract)
W89-04296

BIOGEOGRAPHY OF THE COASTAL WETLANDS OF THE PUGET TROUGH: DELTAIC FORM, ENVIRONMENT, AND MARSH COMMUNITY STRUCTURE,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
I. Hutchinson.
Journal of Biogeography JBIODN, Vol. 15, No. 5/6, p 729-745, September/November 1988. 4 fig, 4 tab, append, 43 ref.

Descriptors: *Deltas, *Marsh plants, *Wetlands, *Marshes, *Puget Trough, Biogeography, Pacific Northwest, Vegetation, River mouth, Salinity gradient, Discharge effectiveness ratio.

Seventeen deltas in the Puget Trough lowlands of the Pacific Northwest were classified on the basis of the morphology and physical environments of their river basin-delta-receiving basin systems. The classification algorithm identified three environmental categories; two of the deltas remained unclassified. A census was conducted of the intertidal marshes of each delta foreshore plant communities were identified by means of the COMPCLUS program, and the community profiles of each delta were used as a basis for the vegetational classification. Three vegetation units were identified. The concordance in the membership of the environmental and vegetational categories suggests that there is a simple relationship between the two. A canonical correlation analysis of nine environmental variables and five plant community variables supported this conclusion; a single dominant linkage between the two sets of variables was identified. This linkage is interpreted as a salinity gradient. The loadings of the Salicornia-Distichlis and Scirpus communities on the canonical variable, and their response patterns with respect to an index variable (Discharge Effectiveness Ratio, which measures the relative magnitude of fluvial and maritime influences at the delta front) constitute the evidence for this interpretation. In contrast to the fairly uniform coastal marshes to north and south, the deltaic mashes of the Puget Trough are composed of a mixture of regional types. Inter-delta variation can be accounted for by the differences in flow volumes and discharge regimes of the contributing rivers, and the exposure of the delta fronts. (Author's abstract)
W89-04312

PYRITE FORMATION IN MARSHES DURING EARLY DIAGENESIS,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
A. E. Giblin.
Geomicrobiology Journal GEJODG, Vol. 6, No. 2, p 77-97, 1988. 8 fig, 3 tab, 56 ref.

Descriptors: *Diagenesis, *Marshes, *Pyrite, *Peat, Sediments, Grasses, Sulfur, Intertidal areas, Sulfur bacteria, Salinity.

Pyrite was removed from peat cores by draining the sediments and allowing the pyrite to oxidize. Then the peat cores were placed back into intertidal salt marsh sediments to incubate. Pyrite accumulated rapidly in peat incubated in situ. A greater accumulation of pyrite was observed in peat that contained living grass than peat in which the grass had been killed. Resin-imbedded samples of peat from nearby sediments showed that small single crystals of pyrite were abundant, supporting the idea that pyrite in marshes forms rapidly through direct precipitation. Pyrite was also observed filling vascular channels in roots. It had been proposed that pyrite fills root channels in freshwater environments where the primary sulfur source used by sulfate-reducing bacteria is organic sulfur rather than sulfate. The widespread occurrence of pyrite filling vascular channels in salt marsh peat makes it unlikely that pyrite morphology can be used to infer the salinity of the overlying water. Marsh sediments are characterized by higher carbon/sulfur ratios and pyritization (Fe-pyrite/(FE-pyrite + Fe-HCl)) indices than marine subtidal sediments. Within wide ranges these indices do not seem to be very sensitive to salinity of flooding water or carbon concentrations in sediments. Oxidation and iron availability appear to be the major controls on pyrite accumulation in marshes. While pyrite concentrations in submerged sediments can be used as indicators of relative rates of sulfate reduction, sulfur storage in intertidal marsh sediments is not as tightly linked to this microbial process. (Author's abstract)
W89-04313

EFFECT OF TEMPERATURE ON RATES OF SULFATE REDUCTION IN MARINE SEDIMENTS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
J. T. Westrich, and R. A. Berner.
Geomicrobiology Journal GEJODG, Vol. 6, No. 2, p 99-117, 1988. 9 fig, 3 tab, 28 ref.

Descriptors: *Sulfates, *Marine sediments, *Temperature effects, *Long Island Sound, Sulfate reduction, Arrhenius Model, Radioactive tracers, Sulfur bacteria.

Rates of sulfate reduction in sediments of Long Island Sound varied as a function of temperature. Temperature dependence was measured either by following changes in rates in intact cores with seasonal changes in temperature, or by conducting laboratory experiments on homogenized sediments under controlled temperatures. At constant temperature, a large range of sulfate reduction rates were observed for the study sites. In both the intact cores and the laboratory experiments, sediments with lower rates of sulfate reduction exhibited a more pronounced temperature dependence. Apparent activation energies determined using the Arrhenius equation show a systematic trend with sulfate reduction rate when temperature was normalized. As the rate of sulfate reduction decreased, the apparent activation energy increased from 36 to 132 kJ/mole. Although this observation can be interpreted in a number of ways, it is suggested that susceptibility of organic matter to metabolic attack exerts an important control on the temperature dependence of sulfate reduction, as well as on the rate itself. The findings indicate that the use of a constant temperature correction for estimating annual rates of sulfate reduction will be inaccurate. (Davis-PTT) (Author's abstract)
W89-04314

CONCURRENT MOBILE ON-SITE AND IN SITU STRIPED BASS CONTAMINANT AND WATER QUALITY STUDIES IN THE CHOPTANK RIVER AND UPPER CHESAPEAKE BAY,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W89-04345

TIDAL INLET HYDRAULICS,
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
A. J. Mehta, and P. B. Joshi.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1321-1338, November 1988. 8 fig, 1 tab, 67 ref.

Descriptors: *Estuaries, *Hydraulics, *Tidal hydraulics, *Channels, *Inlets, Flow characteristics, Numerical analysis, Model studies, Tributaries, Mathematical studies, Tides, Flood flow, Civil engineering..

The unique physiographic features of tidal inlets make it convenient to treat inlet hydraulics in two parts, one pertaining to the channel through the land barrier, and the other to the near-field region characterized by ebb and flood circulations beyond the channel. Theoretical formulations for flow description in these regions lead to approximate but useful analytic solutions in simple cases. For detailed hydraulic description, physical and numerical modeling techniques are widely employed. Limitations in predictive capabilities seem to arise mainly from a lack of fuller understanding of hydromechanical processes. Such interactive phenomena as the propagation of the buoyant jet through ambient sea waters during the ebbing phase of tidal flow, and the influence of waves on the tidal flow regime, require considerable additional scrutiny via field investigations. The complex nature of inlet behavior necessitates the collection of site-specific prototype information as an essential component of hydraulic analysis and interpretation. (Author's abstract)
W89-04359

STOCHASTIC DYNAMIC APPROACH TO PREDICT WATER LEVELS IN ESTUARIES,
Technische Univ. Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
P. G. ten Brummelhuis, B. de Jong, and A. W. Heemink.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1339-1358, November 1988. 7 fig, 2 tab, 25 ref.

Descriptors: *Estuaries, *Mathematical studies, *Water level, *Stochastic process, *Tides, Prediction, Statistical models, Tidal waves, Standard deviation, Wind velocity, Coasts.

A method is presented to predict water levels in tidal estuaries using Kalman filtering techniques. The method is illustrated by predicting the water levels in the Eastern Scheldt. This estuary appears to contain many of the features inherent in modeling flows in estuaries. It is seen that, although the geometry is very complicated due to numerous gullies and banks, a very simple schematization is sufficient. Furthermore, it is shown that nonlinear effects in the mouth due to the complicated geometry and the interaction between the tidal wave along the coast and the water movements in the estuary can be compensated by using stochastic dynamic methods applied to internal boundary conditions. (Author's abstract)
W89-04360

DENITRIFICATION IN COASTAL BAY SEDIMENT: REGIONAL AND SEASONAL VARIATION IN AARHUS BIGHT, DENMARK,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
M. H. Jensen, T. K. Andersen, and J. Sorensen.

Marine Ecology Progress Series MESEDT, Vol. 48, p 155-162, 1988. 4 fig, 1 tab, 35 ref.

Descriptors: *Denitrification, *Marine sediments, *Bays, *Coastal waters, Nutrient load, Primary production, Nitrogen cycle, Denmark, Seasonal variation.

The seasonal pattern of denitrification activity was studied in sediment from three stations in the Aarhus Bight, Denmark. At all three stations, a dramatic increase in denitrification activity was found in early spring coincident with sedimentation of the spring phytoplankton bloom. The maximum of activity was followed by declining rates in the early summer and low and relatively constant rates throughout the rest of the year. For the three sediments, the total range of denitrification activity was < 0.05 to 0.5, 0.05 to 0.7 and 0.2 to 1.0 mmol N/sq m/d, respectively, and the total annual activity 35,70 and 180 mmol N/sq m/yr. Regional differences in activity were comparable to differences in organic content at the three stations; throughout the year, the highest activities were observed in the most organic-rich sediment and lowest were observed in the relatively organic-poor sediment. The results indicate that annual denitrification may increase in response to higher nutrient load and primary production in the coastal sea. (Author's abstract)
W89-04423

DECOMPOSITION OF SPARTINA ANGLICA ROOTS AND RHIZOMES IN A SALT MARSH OF THE WESTERSCHELDE ESTUARY,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
M. A. Hemminga, C. J. Kok, and W. Munck.
Marine Ecology Progress Series MESEDT, Vol. 48, p 175-184, 1988. 7 fig, 2 tab, 47 ref.

Descriptors: *Salt marshes, *Spartina, *Estuaries, *Microbial degradation, *Marsh plants, Aquatic plants, Plant populations, Roots, Rhizomes, Decomposition, The Netherlands.

Decomposition of roots of the salt marsh grass Spartina anglica was investigated using litter bags. The pattern of disappearance of the root material was essentially the same at soil depths of 30, 15, and 3 cm, and above-ground. Average calculated turnover time for S. anglica root material varied between 2.0 and 3.9 yr. These differences are due to variations in decay rates at the various depth levels and marsh locations. At the creek levee and low marsh study site, decomposition rate decreased with depth. This phenomenon was less obvious at the moderately vegetated middle marsh site. A possible explanation of these observations may be found in the interactions of living roots with the decomposer community in the salt marsh sediment. S. anglica roots decomposed faster with increasing elevation of the marsh location, indicating that inundation frequency is an important factor in determining the rate of decay processes. Percentage nitrogen in the litter increased in time, both below-ground and above-ground. There was a strong positive correlation between the percentage nitrogen and the percentage weight loss of root material. In contrast to nitrogen levels, the percentage of extractable protein in the root litter decreased rapidly to undetectable levels a few months after the start of the experiment. This finding underlines the difficulty in interpreting elemental N values in terms of resource quality. The course of protein decrease was similar on all depth levels and locations; this suggests that the transformation of compounds valuable to microbial metabolism, such as proteins, is much less responsive to environmental factors than the majority of plant materials. (Author's abstract)
W89-04425

MICROBIAL RESPONSE TO ORGANIC PARTICLE GENERATION BY SURFACE COAGULATION IN SEAWATER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Biological Oceanography Div.
P. E. Kepkay, and B. D. Johnson.
Marine Ecology Progress Series MESEDT, Vol. 48, p 193-198, 1988. 2 fig, 1 tab, 34 ref.

Descriptors: *Coagulation, *Organic compounds, *Seawater, *Dissolved solids, *Bacteria, *Surface water, Organic particle generation, Carbon dioxide.

Coagulation of organic material onto bubbles and the production of organic particles as the bubbles either dissolve or burst at an air-water interface had a large and well-defined effect on the concentration of dissolved organic carbon (DOC) in a coastal seawater. After only 15 min of bubbling, DOC was reduced by 43%, and the rapid development of a transient microbial community was associated with the production of labile organic particles. Half of the DOC removed by this surface coagulation was respired to CO2 within 3 d, and mineralization rates (209 to 212 micrograms C/l/d) were comparable to primary production rates in even the most productive coastal waters. While surface coagulation is obviously not primary production, it does appear to physically regenerate carbon which remains less accessible to the biota when in the dissolved and colloidal state. This physical regeneration of DOC may be an important part of any pelagic ecosystem based on the consumption of organic particles, but when combined with rapid mineralization of the regenerated material, it could also be a mechanism for recycling a large reservoir of apparently refractory carbon back to CO2 at the ocean surface. (Author's abstract)
W89-04426

OPTICAL PHENOMENA IN DISCHARGE LENSES OF RIVERS,
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
V. I. Burenkov, A. P. Vasil'kov, and A. I. Sud'bin.
Oeanology ONLGAE, Vol. 27, No. 4, p 433, February 1988. 1 ref.

Descriptors: *Rivers, *Optical properties, *Reflectance, *River mouth, Discharge lenses, Solar radiation, Sea brightness coefficient.

In areas where river waters mix with the surrounding sea water, a strong lateral variability in the sea brightness coefficient, a measure of the backscattering of solar radiation by the water, is generally observed in so-called discharge lenses. This variability, which is distinctly observable even with the naked eye, results from dynamic processes that occur when a comparatively thin layer of less dense fresh water with different optical characteristics spreads over the sea surface. Measurements of brightness from ships and helicopters in the area of a discharge lens of the Kodora River (Black Sea) are described. The physical processes responsible for the disturbed optical phenomena are probably related to internal waves propagating at the interface between freshwater and sea water. (Brock-PTT)
W89-04434

EFFECT OF DOMESTIC SEWAGE AND INDUSTRIAL EFFLUENTS ON BIOMASS AND SPECIES DIVERSITY OF SEAWEEDS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
For primary bibliographic entry see Field 5C.
W89-04477

LAND USE AND NITROGEN LOSSES: A STUDY WITHIN THE LAHOLM BAY DRAINAGE AREA OF SOUTHWESTERN SWEDEN,
Halland County Administrative Board, Halmstad (Sweden).
For primary bibliographic entry see Field 5B.
W89-04497

BIOCHEMICAL AND PHYSIOLOGICAL DISTURBANCES IN FISH INHABITING COASTAL WATERS POLLUTED WITH BLEACHED KRAFT MILL EFFLUENTS,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W89-04555

EFFECTS OF POLYNUCLEAR AROMATIC HYDROCARBONS ON FISHES AND SHELLFISH: AN OVERVIEW OF RESEARCH IN VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W89-04556

EFFECTS OF CERTAIN CONTAMINANTS ON EYES OF SEVERAL ESTUARINE FISHES,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W89-04557

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

IRRIGATION WATER FOR VEGETATION ESTABLISHMENT,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
R. E. Ries, F. M. Sandoval, and J. F. Power.
Journal of Range Management JRMGAQ, Vol. 41, No. 3, p 210-215, May 1988. 4 fig, 7 tab, 11 ref.

Descriptors: *Land reclamation, *Impaired water use, *Vegetation establishment, *Irrigation effects, *Strip mines, Precipitation, Forages, Weeds, Saline soils, Water quality, Mine wastes.

This research project was conducted to evaluate the use of irrigation water to supplement precipitation during establishment of perennial forage-plant communities on surface-mined lands in the northern Great Plains. The treatments included precipitation and 9 combinations of various quantities of medium-quality and low-quality water applied to a clay-loam topsoil replaced over a loam minespoil. The response to the added water of a seeded forage-species mixture, volunteer weeds, and changes in salinity and sodicity of the soil/spoil profile were measured. All levels of irrigation, regardless of water quality, increased seeded-species production, but decreased weed dry matter. One season of irrigation with medium-quality or low-quality produced minimal changes in soil salinity and sodicity. Some increase in soil salinity and sodicity was observed when low-quality water was added during the second season. Therefore, low-quality water can be used beneficially to supplement precipitation for 1 or 2 seasons during the establishment of perennial plant communities on moderately-permeable soil/spoil areas. (Author's abstract)
W89-03428

WATER MANAGEMENT AND PROTECTION IN OPENCAST MINING REGIONS AND UTILIZATION OF MINE WATER.
For primary bibliographic entry see Field 4B.
W89-03752

STATE-SPACE DYNAMIC HYDROLOGICAL MODELING OF SOIL-CROP-CLIMATE INTERACTIONS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-03814

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: I. A CONCEPTUAL INTRODUCTION,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 7C.
W89-03984

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: II. FIELD VERIFICATION OF THE THRESHOLD MODEL APPROACH,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 7C.
W89-03985

3D. Conservation In Domestic and Municipal Use

EFFECTS OF CONSERVATION ON DAILY WATER USE,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. T. Shaw, and D. R. Maidment.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 71-77, September 1988. 5 fig, 10 ref. U.S. Geological Survey Agreement UT-86-2.

Descriptors: *Water shortage, *Water conservation, *Water use, Drought, Water demand, Consumptive use, Domestic water, Texas.

Mandatory restrictions on outdoor water use and water rationing were implemented in stages in Corpus Christi, Texas, during the course of a regional drought lasting through most of 1984. The methodology for separating the effects of conservation on daily water use from concurrent effects of weather and seasonal variation is given, enabling a quantitative estimate of the conservation restrictions to be made. These restrictions reduced water use by an average of 29 mgd, compared with a peak water-use rate of about 100 mgd. Subsequent implementation of more stringent restrictions resulted in little additional savings because water use had already decreased to winter base levels. The residual effects of conservation extended through 1985, even after the restrictions were lifted. (Author's abstract)
W89-03878

1988 NATIONAL WATER RATE SURVEY,
Young (Arthur) and Co., Charlotte, NC.
For primary bibliographic entry see Field 6C.
W89-03879

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1985 - NOVEMBER 30, 1986,
Geological Survey, Reston, VA. Water Resources Div.
S. P. Sauer, W. E. Harkness, B. E. Krejmas, and K. L. Vogel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-250, 1987. 86p, 10 fig, 21 tab.

Descriptors: *Delaware River, *Water management, *Regulation, *Inter-basin transfers, Diversion, Release, Drought, Reservoir yield, Supply.

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River Basin (Figure 1) and requires compensating releases from certain reservoirs of the City of New York to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated. During the 1986 report year, December 1, 1985, to November 30, 1986, precipitation and runoff varied from below average to above average in the Delaware River Basin. For the year as a whole, precipitation was 4.3 inches above average. Runoff was near average. Operations were under a status of drought at the beginning of the report year. The drought emergency was terminated on December 18, 1985, by the Delaware River Basin Commission, and operations were returned to normal as prescribed by the Decree for the remainder of the report yr. Storage in the reservoirs increased to capacity during the winter months and all New York City Delaware River Basin reservoirs spilled throughout the year. Diversions from Delaware River Basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 69 days during the June to November period. Releases were made at conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. The excess release quantity as defined by the Decree was not expended by end of the report year. New York City complied fully with the terms of the Decree and with the directives of the River Master during the year. (See also W89-04133) (USGS)
W89-04133

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1984 - NOVEMBER 30, 1985,
Geological Survey, Reston, VA. Water Resources Div.
F. T. Schaefer, W. E. Harkness, and L. D. Cecil.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-606, 1986. 85p, 7 fig, 22 tab.

Descriptors: *Delaware River, *Diversion, *Water management, *Drought, *Interbasin transfers, Release, Reservoir yield, Regulation, Water supply.

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin and requires compensating releases from certain reservoirs of the City of New York to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated. During the 1985 report year, December 1, 1984, to November 30, 1985, precipitation and runoff varied from below average to above average in the Delaware River basin. For the year as a whole, precipitation was near average. Runoff was below average. Operations were under a status of drought warning or drought from January 23, 1984, through the end of the report year. Below-normal precipitation the first half of the year resulted in decreased storage in the reservoirs to record low levels by March 1, 1985. Storage remained at record low levels from March through September. Above-normal precipitation in September and November served to break the drought and increase storage into the normal zone of the operating curves for the reservoirs. Diversions from the Delaware River basin by New York City did not exceed those authorized by the terms of the Amended Decree or those invoked by the several emergency conservation measures throughout the year. There were no diversions from the Delaware River basin by New Jersey during the year. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 82 days between June 14 and September 28. Releases were made at conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. (See also W89-04133) (USGS)
W89-04152

3E. Conservation In Industry

ECONOMETRIC STUDY OF INDUSTRIAL WATER DEMANDS IN BRITISH COLUMBIA, CANADA,
British Columbia Univ., Vancouver. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W89-03797

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1985 - NOVEMBER 30, 1986,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 3D.
W89-04133

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1984 - NOVEMBER 30, 1985,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 3D.
W89-04152

3F. Conservation In Agriculture

ANNUAL CYCLES OF PHYSICAL AND BIOLOGICAL PROPERTIES IN AN UNCULTIVATED AND AN IRRIGATED SOIL IN THE SAN JOAQUIN VALLEY OF CALIFORNIA,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 2G.
W89-03411

SNOW DISTRIBUTION ON CROP FIELDS,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 2C.
W89-03413

CROP WATER USE AND WATER CONSERVATION BENEFITS FROM WINDBREAKS,
Soil Conservation Service, Lincoln, NE.
G. L. Dickey.
Agriculture, Ecosystems and Environment, Vol. 22/23, p 381-392, August 1988. 6 fig, 1 tab, 31 ref.

Descriptors: *Water conservation, *Crop production, *Water use, *Windbreaks, Crop yield, Infiltration, Precipitation, Evaporation, Soil surfaces, Water use efficiency.

Benefits from windbreaks and other water-conservation practices can be measured by yield comparisons of protected and unprotected sites. This change in yield reflects an integrated response of the parameters involved such as increased water-application efficiency, increased infiltration and storage from snow or rainfall, reduced evaporation from the soil surface, and the ability of plants to use the stored moisture more efficiently. A standard method is proposed for evaluating the benefits of windbreaks based on converting the change in crop yield to an equivalent change in water use. The equivalent water can be used to estimate changes in yields for other crops in the rotation system. The method is also applicable for evaluating the benefit of other conservation practices where yield differences are known. A distance of 10 windbreak heights (10h) is proposed as a standard for evaluating the effects of windbreaks on crop yield. (Author's abstract)
W89-03414

EFFECTS OF SHELTER ON PLANT WATER USE,
Nebraska Univ.-Lincoln. Dept. of Forestry, Fisheries and Wildlife.
J. E. Davis, and J. M. Norman.
Agriculture, Ecosystems and Environment, Vol. 22/23, p 393-402, August 1988. 1 fig, 30 ref.

Descriptors: *Water use, *Crop production, *Windbreaks, *Shelterbelts, *Vegetation effects, Agriculture, Plant growth, Water use efficiency, Microclimate, Turbulent flow.

Windbreaks and shelterbelts are often used in agriculture to modify crop environments, because it is widely believed that plant survival, growth, and reproduction are improved above that which would be expected of unsheltered plants. A substantial part of the effect of shelter has been ascribed to a beneficial change in the way in which sheltered plants use water, particularly during periods when water is greatly limited. The concept of water-use efficiency (WUE) was reviewed; the ratio of carbon gained to water lost through the stomata, and an attempt was made to explain how shelter might influence WUE due to changes in the microclimate around the plants in its lee. Because the microclimate around shelters is so complex, conceptual models were relied on heavily, in par-

ticular the idea that shelter might 'decouple' plants from their atmospheric environment. It seems certain that the reduction in turbulent transfer contributes to improved water-use efficiency in shelter under many situations; however, this improvement cannot be assumed to hold for all shelter conditions. (Author's abstract)
W89-03415

PLANTING DATE, ROW SPACING, AND IRRIGATION EFFECTS ON SOYBEAN GROWN ON CLAY SOIL,
Agricultural Research Service, Stoneville, MS. Soybean Production Research Unit.
L. G. Heatherly.
Agronomy Journal AGJOAT, Vol. 80, No. 2, p 227-231, March-April 1988. 6 tab, 20 ref.

Descriptors: *Soil-water-plant relationships, *Crop production, *Irrigation effects, *Soybeans, *Clays, Weather, Planting management, Mississippi River, Alluvial plains, Mississippi, Crop yield, Statistical analysis, Seeds, Drought.

Because of adverse weather and management decisions, soybean is often planted beyond the period considered optimum. In the southern Mississippi River alluvial plain, this frequently occurs on clay soil. Research was conducted from 1984 through 1986 in Mississippi on Sharkey clay (very fine, montmorillionitic, nonacid, thermic Vertic Haplaquept) to determine the effect on seed yield and yield components of early or mid-May versus late-June plantings of soybeans. The cultivar 'Braxton' was planted in 0.53-m-wide and 1.02-m-wide rows and was either nonirrigated or irrigated. Irrigation significantly increased yield regardless of row spacing or planting date, but the increase was always greater for early plantings. Without irrigation, yield differences between planting dates were not significant. Narrow rows produced 100 kg/ha more seed when averaged over all environments, and row spacing did not significantly alter the planting date/treatment interaction. Yield increases from irrigation were primarily attributable to increased number of seed. These results show that (1) late planting of soybean on clay soil in either row spacing used will result in significant yield decline even with irrigation, (2) nonirrigated production of soybean on clay soil is risky, and (3) choice of row spacing is not as important as is the alleviation of drought stress on this soil type regardless of planting date. (Author's abstract)
W89-03416

SEASONAL AND SOIL FERTILITY EFFECTS ON THE RESPONSE OF WATERLOGGED COTTON TO FOLIAR-APPLIED NITROGEN FERTILIZER,
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
A. S. Hodgson, and D. A. MacLeod.
Agronomy Journal AGJOAT, Vol. 80, No. 2, p 249-265, March-April 1988. 1 fig, 7 tab, 24 ref.

Descriptors: *Soil-water-plant relationships, *Nitrogen, *Fertilization, *Waterlogging, *Cotton, *Fertility, Australia, Furrow irrigation, Crop yield, Limiting nutrients, Clays, Climatic data, Absorption, Plant growth, Roots, Factor analysis.

The majority of irrigated cotton soils in Australia are poorly-drained, and the short-term waterlogging associated with extended furrow irrigation reduces cotton yield, partly by reducing the uptake of nitrogen. Foliar application of N before irrigation can overcome a transient shortage, but yield responses have been variable. A cracking gray clay soil (Typic Pellustert) was waterlogged by furrow irrigations lasting 4 to 32 h. Climatic and soil-fertilizer conditions included a cool, moist season with optimal soil fertilizer N; a hot, arid season with high soil-fertilizer N; and a hot, arid season with a wide range of soil-fertilizer N. Foliar N was applied at 0, 5, 10, and 20 kg/ha in the first season; 0, 15, 30, and 60 kg/ha in the second season; and 0, 60, 120, and 180 kg/ha in the third season. Increased waterlogging reduced N uptake and lint yield. Nevertheless, there was no response to foliar N in the cool, moist season because factors other than N-limited growth and yield whether or not N was supplied to the foliage. Lack of response to foliar N in the hot, arid season with high soil-N fertility was attributed to the high uptake of N (163 kg N/ha) by untreated shoots, which compensated for reduced uptake by the roots during waterlogging. A three-factor interaction in the third season confirmed that more cotton yield was recovered by applying foliar N under more severe waterlogging when soil-N levels were not high. The results confirmed that foliar N can ameliorate the effects of waterlogging in cotton, defined some of the conditions under which responses to foliar N occur, and explained some of the variability in response to foliar N found under commercial conditions. (Author's abstract)
W89-03417

SOIL MANAGEMENT TO PREVENT EARTHWORMS FROM RIDDLING IRRIGATION DITCH BANKS,
Agricultural Research Service, Kimberly, ID.
W. D. Kemper, P. Jolley, and R. C. Rosenau.
Irrigation Science IRSCD2, Vol. 9, No. 2, p 79-87, 1988. 3 fig, 6 ref.

Descriptors: *Irrigation ditches, *Soil management, *Earthworms, *Bank protection, Animal behavior, Burrows, Soil compaction, Soil water, Furrow irrigation, Soil porosity, Subsoil, Topsoil, Water loss.

Earthworm activities were observed under subdued light in lucite-fronted soil-filled boxes in which bean plants were growing. The worms formed their burrows by ingesting a relatively small core of soil about 2 mm in diameter and expanding these holes to a diameter of about 5 mm by flexing their muscles. The compacted zone extended about 4 mm from the radii of these burrows. As shallow bean roots of young plants extracted water from the upper portions of the soil, the worms moved downward to moister soil. During furrow irrigation, the worms moved toward the water source through existing burrows. A few of them burrowed new holes to the furrow and emerged and swam in the water for up to 20 min before burrowing back into the mud in the bottom of the furrow. In columns with sections packed with pressures of 50, 100, 200, 300, and 600 kPa, worm burrowing was reduced in sections packed at higher pressures and was practically negligible in the sections packed at 600 kPa. Visual comparison of porosity in the compacted soil surrounding earthworm burrows and the soil compacted at 300 and 600 kPa indicated that the worms are able to survive long enough to burrow through 15 cm of a subsoil with organic carbon content less than 0.2% that lay between them and topsoil. Both compaction and use of subsoil for the banks show promise for reducing earthworm burrowing and water loss from ditches. (Author's abstract)
W89-03421

PATTERNS OF WATER WITHDRAWAL BENEATH AN IRRIGATED PEACH ORCHARD ON A RED-BROWN EARTH,
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinity.
K. A. Olsson, and C. W. Rose.
Irrigation Science IRSCD2, Vol. 9, No. 2, p 89-104, 1988. 6 fig, 3 tab, 25 ref.

Descriptors: *Irrigation practices, *Soil-water-plant relationships, *Peaches, *Orchards, *Soil types, *Withdrawal, Roots, Loam, Soil moisture deficiency, Root distribution, Transpiration, Water storage, Soil structure, Sprinkler irrigation.

Relationships between water uptake by roots, root concentration, and soil-water suction were explored over protracted drying cycles. The soil was a Shepparton fine sandy loam and comprised a surface soil 16.5 cm deep over a massive, slowly-permeable B horizon (54% clay) to 60 cm; below 60 cm and extending to 150 cm was a fine-textured layer (40% clay) of higher permeability than the B horizon. In the early stages of drying, water uptake by roots was well-correlated with root concentration over the profile but, over time, water uptake was redistributed over the root system. Theoretical analysis suggests that poor utilization of water from depth on this soil was associated mainly with low root concentrations and low root (radial) conductance. Thus, in this soil the trees had access to only a limited amount of water to support transpiration. To enhance rates of water supply to the crop and to allow greater flexibility with irrigation applications on such shallow soils, full use should first be made of the limited volume of surface soil for root growth and water storage. Full utilization of the water stored at depths below 60 cm on the Shepparton soil presumably requires higher root concentrations, but extensive modification of soil structure would be required to overcome soil physical limitations to root growth. Alternatively, modern irrigation methods in the orchards using, for example, fine sprinklers allow a high degree of control over water supply to the crop thus reducing the dependence of the crop on water stored at depth. (Shidler-PTT)
W89-03422

SIMULATION OF THE SOIL-WATER DYNAMICS AND CORN YIELDS UNDER DEFICIT IRRIGATION,
Katholieke Univ. Leuven (Belgium). Soil and Water Engineering Lab.
J. Dierckx, J. R. Gilley, J. Feyen, and C. Belmans.
Irrigation Science IRSCD2, Vol. 9, No. 2, p 105-125, 1988. 9 fig, 2 tab, 26 ref.

Descriptors: *Model studies, *Soil-water-plant relationships, *Computer models, *Irrigation practices, *Corn, *Crop yield, *Simulation, Mathematical models, Hydrologic budget, Plant growth, Model testing, Soil properties, Evapotranspiration, Moisture stress.

A model capable of predicting the yield response to a limited water supply was developed by combining two existing mathematical models--a soil water-balance model and a crop-growth model. The resulting computer model was evaluated using experimental data taken under a wide range of soil-moisture conditions. Minor changes were made to each model in an effort to improve the accuracy of the combined model. The model input parameters were derived entirely from published literature. The experimental data necessary for model validation were available from irrigation studies at the Sandhills Agricultural Laboratory of the University of Nebraska. These experiments not only provided the required input soil and climatic data, but also the observed irrigation levels, soil-moisture distributions, and crop yield required for model validation. Initial evaluation indicates that the combined model adequately describes crop evapotranspiration, soil-moisture extraction, and crop yield under a fairly wide range of soil-moisture stress. Additional modification for the prediction of leaf-area expansion and senescence, especially under moisture stress, are needed to improve the accuracy of the model. (Author's abstract)
W89-03423

GROWTH AND YIELD OF SOYBEANS UNDER WET SOIL CULTURE AND CONVENTIONAL FURROW IRRIGATION IN SOUTH-EASTERN AUSTRALIA,
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinity.
G. C. Wright, C. J. Smith, and I. B. Wilson.
Irrigation Science IRSCD2, Vol. 9, No. 2, p 127-142, 1988. 7 fig, 5 tab, 31 ref.

Descriptors: *Furrow irrigation, *Soil-water-plant relationships, *Plant growth, *Crop yield, *Soybeans, *Australia, Soil moisture deficiency, Waterlogging, Water stress, Plant tissues, Plant physiology, Photosynthesis, Crop production, Soil types, Irrigation efficiency.

An experiment was conducted to determine responses of two soybean cultivars (Ridley and Sab40) grown on raised beds with continuous water applied in furrows (wet soil culture--WSC), and with conventional furrow irrigation applied at soil water deficits of 35 mm (F) and 70 mm (I). The early growth and leaf-area development of both cultivars was reduced by both waterlogging

(WSC) and water-stress (I) effects compared with the frequently-irrigated (F) treatment. Both cultivars acclimated to the WSC conditions and resumed active growth rates comparable to the F treatment. Excessive dry-matter accumulation in leaves and stems of Ridley under WSC resulted in severe lodging and significantly reduced grain yield compared with Ridley under F irrigation. Physiological analysis showed that under WSC Ridley had a substantially lower light-use efficiency (compared with the F-irrigated crop) during reproductive growth. It is hypothesized that lodging during this period reduced photosynthate supply as a result of detrimental changes in the pattern of leaf illumination through the canopy. The cultivar Sab40 did not lodge under WSC and grain yield was not significantly different from the F-irrigated treatment. Further studies on the response of lodging-resistant cultivars to WSC are required to fully assess this technique under commercial conditions. More importantly, studies on soybean production in relation to crop water use and deep drainage losses on a range of soil types are needed to demonstrate that irrigation water is used as efficiently as with conventional methods. (Author's abstract)
W89-03424

COTTON GROWTH AND PRODUCTION UNDER DRIP-IRRIGATION RESTRICTED SOIL WETTING,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
Z. Plaut, A. Carmi, and A. Grava.
Irrigation Science IRSCD2, Vol. 9, No. 2, p 143-156, 1988. 7 fig, 4 tab, 25 ref.

Descriptors: *Drip irrigation, *Soil-water-plant relationships, *Cotton, *Plant growth, *Crop production, Soil water, Root systems, Root distribution, Irrigation practices, Plant populations, Field tests, Loess, Loam, Israel, Moisture gradient.

Control of optimal soil-water status for high productivity can be achieved more easily when the volume of the root system is restricted than with an extended root system. The restricted root system was obtained by planting on a predried soil profile and by irrigation with a drip-irrigation system applying small quantities of water at high frequencies. The effects of plant population, row and drip lateral densities, and the amount of water per application on soil-water distribution and on cotton growth and productivity under these conditions were determined during 3 years of field trials. Cotton (cultivar Acala SJ-2) was grown in a loess-brown loam soil in the northern Negev of Israel. Maximal lint production was obtained within a narrow range of irrigation-water quantities. Quantities below this range enhanced vegetative growth and plant height and reduced lint formation. It was concluded that an optimal moisture regime can be obtained more easily by restricting the size of the root zone, but that over-irrigation may easily occur under such conditions. An increase in population over 10 plants/square m resulted in enhanced vegetative growth associated with a reduction in lint yield with all irrigation regimes. A row-to-lateral ratio of 2, and location of the laterals between alternate rows led to a greater vertical gradient in soil-water content as compared with a row-to-lateral ratio of 1. Lint production was increased and vegetative growth was decreased by a row-to-lateral ratio of 2. (Author's abstract)
W89-03425

SIMULATION OF CROP-IRRIGATION SYSTEMS,
Bangladesh Agricultural Univ., Mymensingh. Dept. of Farm Power and Machinery.
B. K. Bala, M. A. Satter, M. A. Halim, and M. S. U. Talukdar.
Agricultural System AGSYD5, Vol. 27, No. 1, p 51-65, 1988. 7 fig, 4 tab, 16 ref.

Descriptors: *Model studies, *Soil-water-plant relationships, *Simulation, *Crop production, *Irrigation, Crop yield, Hydrologic budget, Soil water, Evapotranspiration, Precipitation, Model testing.

Previous efforts in the simulation of crop-irrigation systems were reviewed and carefully examined. A model based on the system-dynamics approach of Forrester was developed to assist farmers in determining the date and volume of water to apply to each field and the expected yields. The model accounted effectively for feedback loops and nonlinearity in the real-world system. The model was based on a water balance of soil moisture, evapotranspiration, irrigation, precipitation, and deep percolation, and grain yield was predicted. The validity of the model was tested using experimental data of wheat grown in a lysimeter. The predicted soil moistures, cumulative evapotranspirations and grain yields were in good agreement with actual observed values for different treatments of irrigation. (Author's abstract)
W89-03427

ESTIMATES OF CONSUMPTIVE USE AND GROUND-WATER RETURN FLOW USING WATER BUDGETS IN PALO VERDE VALLEY, CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-03792

INTERNATIONAL INSTITUTE FOR LAND RECLAMATION AND IMPROVEMENT: ANNUAL REPORT 1987.
For primary bibliographic entry see Field 6E.
W89-03793

IRRIGATION WATER MANAGEMENT IN THE TUNGABHADRA SCHEME, INDIA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
M. Jurriens, V. Ramaiah, and J. G. van Alphen.
IN: International Institute for Land Reclamation and Improvement: Annual Report 1987. Wageningen, The Netherlands. 1988. p 22-32, 4 fig, 2 tab, 6 ref.

Descriptors: *Irrigation programs, *Irrigation efficiency, *India, *Water management, *Water policy, Research priorities, Water scarcity, Regional planning, Water supply, Water distribution, Farming, Agriculture.

A number of water management aspects in the Left Bank Command Area of the Tungabhadra Project are discussed and some information given on the background and contents of its research program. The Project was designed for what is called in India 'protective irrigation'. This means that the supply of irrigation water is limited, not covering the full crop water requirements, but only intended to protect the farmer from a complete crop failure. The limited available water in the reservoir is shared by as many farmers as possible, instead of providing fewer farmers with full supplies. The major problems in the Scheme are those common in many schemes around the world: inequitable water distribution all over the command area and the related low irrigation intensities. Since the start of the Scheme in 1954, various recommendations have been made concerning canal lining, warabandi (farm rotation), and modifying crop localization patterns. In response to these problems, a research program was established. Its objectives are to increase the irrigation efficiencies in order to ensure the supply and equitable distribution of water to all farmers, and to contribute to the solution of the problems of waterlogging and salinity. An observation made thus far in the research program is that the policy criterion of protective irrigation underlies many of the problems in the Scheme. Most of the research activities are still underway or have yet to start. (See also W89-03793) (Fish-PTT)
W89-03795

PUBLIC TUBEWELL DEVELOPMENT IN THE STATE OF UTTAR PRADESH, INDIA,
R. van Aart, M. L. M. Kooijman, R. Lageman, and L. H. Sprey.
IN: International Institute for Land Reclamation and Improvement: Annual Report 1987. Wageningen, The Netherlands. 1988. p 33-49, 5 fig, 5 tab, 3 ref.

Descriptors: *Irrigation wells, *India, *Irrigation programs, *Water management, *Farm management, *Cost-benefit analysis, Pump wells, Public policy, Water supply development, Farming, Economic aspects, Operating costs, Project planning.

Uttar Pradesh is the leading Indian State for well irrigation in areas that cannot be reached by canal water. Public tubewell irrigation commenced in the mid-1930s, and by 1950 about 5000 tubewells were in operation. Since 1960, the number of public and private tubewells has increased steadily to more than 24,000 State and 1.2 million private tubewells by 1984. Environmental conditions in Uttar Pradesh, such as climate, physiography, hydrology, hydrogeology, soils, and land use and cropping are discussed. Public tubewell schemes are described in terms of layout, selection and development of suitable sites, typical components of a system, operation and maintenance of a system, farming systems, and conditions in areas without public tubewell systems. Farm income due to tubewell irrigation can be established through a financial analysis assuming current prices, farm types, crop patterns, variable costs, and water charges. Farmers can considerably increase their income after the installation of a tubewell irrigation system. The additional costs are by far surpassed by the value of the incremental production. When the costs and benefits of tubewell irrigation are analyzed at the State level, a similar conclusion can be drawn. (See also W89-03793) (Fish-PTT)
W89-03796

STATE-SPACE DYNAMIC HYDROLOGICAL MODELING OF SOIL-CROP-CLIMATE INTERACTIONS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. L. Protopapas, and R. L. Bras.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1765-1779, October 1988. 8 fig, 22 ref.

Descriptors: *Soil-water-plant relationships, *Hydrologic models, *Agricultural hydrology, *Climatology, Crop production, Soil chemistry, Saline soils, Irrigation, Mathematical models.

The basic biological and hydrological processes of plant growth, such as CO2 assimilation, transpiration, growth, maintainance, and water uptake are discussed and quantified mathematically. A model is constructed in state-space form to simulate the seasonal growth of a crop under variable climatic forcing. The model takes into account the soil moisture and salinity profiles in a soil column. Salinity and moisture profiles are obtained by numerically solving the relevant mass transport equations. the morphology of the root system, which controls sink terms in the equation for transient unsaturated-saturated water transport is explicitly determined by distributing the produced root biomass over depth so that the water uptake rate is maximized. The salinity concentration profile is used for predicting osmotic effects on the behavior of roots. A case study for maize is presented. The crop response depends drastically on the climatic forcing, the soil salinity, and the irrigation practice. Necessary conditions for optimal growth are investigated. the temporal variation of many crop and soil variables is discussed. Finally, the ability of the model to produce the crop production function is demonstrated. (Author's abstract)
W89-03814

EVALUATION OF A DRAINAGE COEFFICIENT FOR BROOKSTON CLAY SOIL,
Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 2G.
W89-03827

INFLUENCE OF DEPTH AND SPACING OF TILE DRAINS ON CROP PRODUCTIVITY IN NILE DELTA,
Soil and Water Research Inst., Giza (Egypt).
A. T. A. Moustafa, W. H. Ahmed, A. C. Chang, and G. J. Hoffman.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1374-

1377, September-October 1987. 6 tab, 12 ref.

Descriptors: *Subsurface drainage, *Drain spacing, *Tile drains, *Crop production, *Water management, Egypt, Economic efficiency.

An agricultural drainage experiment with tile drains installed at lateral spacings of 12.5, 25 and 50 m and drain depth of 1.2 and 1.5 m was initiated in Egypt in 1976 to examine long-term effects of drainage on crop production. The experimental fields were planted to cotton, clover, rice and wheat in rotation. Data from the 3 completed cropping cycles indicated that yields of all crops improved significantly after installation of subsurface drainage systems. The yield increases of field drained with 12.5 and 25 m lateral spacings were, respectively, 39 and 16% higher than that with 50 m lateral spacing. Under the condition of this experiment, the drain depths of 1.2 m and 1.5 m did not significantly affect the crop production. By installing drainage systems, net profits of crop production may increase 5 to 8 times. Lateral spacing and drain depths, however, did not appear to significantly affect the financial return. To maximize the net profit and to minimize the capital investment, drains with 50 m lateral spacing are most appropriate for the situation in Egypt. (Author's abstract)
W89-03830

ECONOMIC OPTIMIZATION OF FURROW IRRIGATION WITH UNIFORM AND NONUNIFORM SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. W. Wallender, and M. Rayej.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1425-1429, September-October 1987. 5 fig, 1 tab, 11 ref.

Descriptors: *Furrow irrigation, *Economic aspects, Agricultural engineering, Soil types, Uniform soil, Nonuniform soil.

A furrow irrigation system was economically optimized for maximum profit on both uniform and nonuniform soil. Flow rate and cutoff time were design (decision) variables and a volume balance hydraulic model simulated irrigation on both soils. Optimum flow rate was higher, cutoff time was shorter and profit was less under nonuniform soil conditions tested, compared with the results of the uniform soil. As water price increased or cotton price decreased, optimum flow rate and cutoff time decreased giving less profit. (Author's abstract)
W89-03836

ABBREVIATED SPRINKLE IRRIGATION EVALUATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. W. Wallender, and S. Ohira.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1430-1434, September-October 1987. 8 fig, 7 ref.

Descriptors: *Sprinkler irrigation, *Agricultural engineering, Sprinkler spacing, Computer models, Application depth.

Computer simulation or uniformity and water application depth as a function of sprinkler spacing along the mainline and lateral was used to study an abbreviated method of evaluating performance of periodic and solid set sprinkle irrigation systems under no-wind conditions. A full-scale 2-dimensional grid layout of collectors was abbreviated to 10 collectors equally spaced between 2 sprinklers along the lateral. According to the simulations, the abbreviated method can replace full-scale evaluation when mainline spacing is less than 0.65 wetted diameters (0.65 D). This does not exceed the recommended mainline design spacing of 0.65 D for no-wind conditions. Further, since recommended lateral spacing is not to exceed one-half mainline spacing, lateral spacing is at most 0.65/2. Agreement between abbreviated and full-scale results applies to lateral spacings in excess of 0.65/2. Although the method shows promise for predicting uniformity, it is less effective for predicting average water application. However, average water application depth can be calculated from sprinkler flow measurement and sprinkler spacing. (Author's abstract)
W89-03837

BY-PASS TANK SYSTEM FOR CHEMICAL INJECTION INTO IRRIGATION PIPE,
A. S. Bennett, D. D. Fangmeier, and E. B. Hundtoft.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1435-1439, September-October 1987. 4 fig, 2 tab, 5 ref.

Descriptors: *Agricultural engineering, *Agricultural chemicals, Chemical application, By-pass tank system, Water tanks.

A low energy by-pass system for injection of chemicals into irrigation systems was designed and tested. The system will operate using pressure differentials of less than 1 kPa, which can be obtained from fittings or components inherent in the irrigation system. Theoretically, 3 tank volumes must be displayed to inject 95% of the chemical. In the system tested, this occurred when the Reynolds number in the tank was at least 1300. The by-pass system was found to be a low-cost method for injecting chemicals when the amount of chemicals is important, but the chemical concentration is not a consideration. (Author's abstract)
W89-03838

EXTENSION'S ROLE IN SOIL AND WATER CONSERVATION,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 4D.
W89-03892

MULTIVARIATE STATISTICAL ANALYSIS OF POTASSIUM AND CHLORIDE REDISTRIBUTION FROM A LINE-SOURCE SPRINKLER EXPERIMENT,
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-04011

OPTIMIZATION TECHNIQUE FOR ESTIMATING INFILTRATION CHARACTERISTICS IN BORDER IRRIGATION,
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
B. L. Maheshwari, A. K. Turner, T. A. McMahon, and B. J. Campbell.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 13-24, April 1988. 4 fig, 3 tab, 29 ref.

Descriptors: *Infiltration, *Soil properties, *Soil water, *Irrigation, Mathematical studies, Comparison studies, Spatial variation.

Because infiltration characteristics of soil vary spatially and temporally in a field, available methods for their estimation in border irrigation are either not suitable or have limitations for their field use. An optimization technique based on the volume balance approach was developed for estimating infiltration characteristics. Five different infiltration equations (Kostiakov, modified Kostiakov, Philip, Horton, and Collis-George) were employed. The method was applied to data obtained from experiments on border irrigation for five different soil types. All equations except that of Philip fitted the data satisfactorily. This result may be explainable by the assumptions inherent in the derivation of the Philip equation and the spatial variability of infiltration in the field. (Author's abstract)
W89-04205

SIMPLE DATED WATER-PRODUCTION FUNCTION FOR USE IN IRRIGATED AGRICULTURE,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
N. H. Rao, P. B. S. Sarma, and S. Chander.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 25-32, April 1988. 2 fig, 2 tab, 28 ref.

Descriptors: *Water stress, *Irrigation, *Model studies, Comparison studies, Crop yield, Stewart-Hagen-Pruitt model, Jensen model, Agriculture, Mathematical models.

The dated water-production functions commonly used in irrigation-optimization models are reviewed briefly and, based on the heuristic assumption that the Boolean principle is applicable, a simple multiplicative dated water-production function is proposed. The function has been compared with the Stewart-Hagan-Pruitt and Jensen models for a number of crops. The proposed model is applicable over a wide range of stress conditions and can be used in locations where experimental data on crop water use and yield are sparse. (Author's abstract)
W89-04206

OPTIMUM SORGHUM PLANTING DATES IN WESTERN SUDAN BY SIMULATED WATER BUDGETS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
M. A. Omer, K. E. Saxton, and D. L. Bassett.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 33-48, April 1988. 6 fig, 7 tab, 35 ref.

Descriptors: *Sorghum, *Sudan, *Hydrologic budget, *Dry farming, *Soil-water-plant relationships, Simulation, Water stress, Seasonal variation, Soil water, Tropical zone, Soil-Plant-Air-Water Model, Model studies, Optimization, Prediction, Farm management, Planting management.

The Soil-Plant-Air-Water (SPAW) model was used to simulate soil water budgets and crop water-stress for sorghum in the dryland region of western Sudan. Limited climatic data were combined with general observations of sorghum growth and soils to provide daily water budgets at one site for 11 years. Probability distribution of computed water budget components and water-stress index resulting from simulation of nine possible planting dates for each year were used to determine the optimum planting period for minimal crop water stress. The water budget analysis showed a distinct optimum planting period of June 20 to July 10, with planting in early July as the most likely for best production. These results agreed well with general experience. The technique will be similarly useful for other locations, for research designs of soil water management, yield forecasting, and planning and management of agricultural resources. (Author's abstract)
W89-04207

RAINFALL IRREGULARITY AND SOWING STRATEGIES IN SOUTHERN MOZAMBIQUE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2I.
W89-04208

EVAPOTRANSPIRATION, PAN EVAPORATION AND SOIL WATER RELATIONSHIPS FOR WHEAT (TRITICUM AESTIVUM),
Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W89-04209

ECONOMIC EVALUATION OF SUGAR CANE PRODUCTION UNDER DIFFERENT WATER SUPPLY SYSTEMS IN THAILAND,
Euroconsult, Arnhem (Netherlands).
W. J. Brzesowsky, and A. E. M. Van Vilsteren.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 83-91, April 1988. 1 fig, 5 tab, 14 ref.

Descriptors: *Economic aspects, *Irrigation, *Sugarcane, *Thailand, Sugar crops, Crop yields, Water requirements, Optimization, Pricing, Irrigation requirements, Cost-benefit analysis.

The relationship between sugar cane yield and rainfall/irrigation requirements is discussed. Special attention is given to the potential sugar cane

yields and cost/benefit ratios in the Malaiman area of Thailand, under four water conveyance systems (from low- to high-density irrigation and drainage network) and under optimized rainfed cultivation. A linear relationship between cane yield and water use was applied for the prediction of potential crop yields for the various water conveyance systems. These yields were compared with the actual cane production in pilot areas with different irrigation infrastructure, which has been monitored over a period of years. Actual yields fell short of predicted ones in all cases. This outcome is attributed mainly to the low cane prices, which resulted in sub-optimal cultivation practices by farmers. Prediction of potential sugar cane yields for local circumstances is quite possible. At present sugar cane price levels, development of a low-density irrigation infrastructure seems to be the most economical solution. (Author's abstract)
W89-04210

MACDRAIN: A SURVEYING, MAPPING, AND DRAINAGE DESIGN SYSTEM FOR THE MICROCOMPUTER,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W89-04214

STOCHASTIC MODELLING OF RUNOFF FROM AN AGRICULTURAL WATERSHED IN SOUTHERN SASKATCHEWAN,
Agriculture Canada, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 2E.
W89-04215

SOIL-WATER DYNAMICS AND OPTIMUM OPERATING REGIME IN TRICKLE-IRRIGATED FIELDS,
Southampton Univ. (England). Inst. of Irrigation Studies.
G. S. Ghali, and Z. J. Svehlik.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 127-143, June 1988. 8 fig, 1 tab, 13 ref, append.

Descriptors: *Soil water, *Trickle irrigation, *Irrigation efficiency, *Irrigation requirements, *Soil-water-plant relationships, Soil moisture deficiency, Soil texture, Simulation analysis, Root zone, Evapotranspiration, Optimization.

The search for optimum irrigation regimes in trickle-irrigated fields can best be undertaken by detailed analysis of soil-water dynamics, and the examination of the significance of the various moisture-depletion mechanisms from the root zone. By numerical simulations, it was possible to examine the relations between the various operating and field conditions, and water usage. The emphasis has been on selecting a rate of water application that minimizes moisture depletion from the root zone, except that due to plant water uptake. By establishing a relationship between the ratio of evapotranspiration to moisture dispersion, and the rate of water application it is possible to identify the rate of water application to maintain the predetermined moisture in the root zone at minimum depletion due to dispersion and evaporation. In medium-textured soils, a supply-demand criterion was shown to be applicable. In course-textured soils it was found that the optimum rate of water application must be much higher than the evaporative demand to minimize drainage below the root zone. (White-Reimer-PTT)
W89-04258

WATER MANAGEMENT PLAN FOR THE AL-HASSA IRRIGATION AND DRAINAGE PROJECT IN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
W. Abderrahman.
Agricultural Water Management AWMADF, Vol. 13, No. p 185-194, June 1988. 3 fig, 3 tab, 8 ref.

Descriptors: *Saudi Arabia, *Ground water management, *Water resources development, *Project planning, *Irrigation programs, *Drainage programs, Irrigation practices, Water conservation, Cultivated lands, Water reuse.

The Al-Hassa Irrigation and Drainage Project delivers approximately 328 million cu m of spring water every year to about 22,000 farms comprising 7096 ha. During the last 5 years, cultivated areas have increased, causing a water shortage problem. A new management scheme is suggested to expand the irrigated areas, overcome the water shortage, and conserve groundwater resources in the region. The scheme introduces automation to the irrigation system, the adoption of a scientifically based irrigation schedule, and improvement of on-farm irrigation methods to lessen water demands. The scheme also includes measures to increase the use of non-conventional water resources such as the reuse of waste water and brackish agricultural drainage water.(Author's abstract)
W89-04262

MODELING OF THE INFILTRATION PROCESS IN ARID ZONES FOR IRRIGATION PROJECT PURPOSES WITH THE AID OF THE 'SYSTEME HYDROLOGIQUE EUROPEEN' (SHE),
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France). Applied Mathematics Dept.
M. Erlich.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 195-210, June 1988. 14 fig, 1 tab, 18 ref.

Descriptors: *Model studies, *Infiltration, *Irrigation programs, *Hydrologic cycle, *Arid zone, Evapotranspiration, Irrigation practices, Soil water.

The model takes into account the evapotranspiration process (ET component) and the circulation of water in the unsaturated zone (UZ component) as a part of the general deterministic, distributed and physically-based modular system. Different irrigation scenarios regarding the amount of water applied and the irrigation process duration are introduced as upper boundary conditions for the soil column. The calibrated model is used for short- and long-term simulations and the results obtained serve both as a test for the numerical algorithms of the European Hydrological System or Systeme Hydrologique Europeen (SHE) and as a decision-aid tool for irrigation water management.(Author's abstract)
W89-04263

MODELLING AND SIMULATION IN HYDROLOGIC SYSTEMS RELATED TO AGRICULTURAL DEVELOPMENT: STATE OF THE ART,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
R. A. Feddes.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 235-248, June 1988. 11 fig, 14 ref.

Descriptors: *Hydrologic Systems, *Model studies, *Crop production, *Irrigation practices, Agricultural hydrology, Irrigation, Simulation analysis, Mathematical studies, Soil water, Plant growth, Crop yield, Water use, Hydrologic budget.

Irrigation regimes can be evaluated with soil water balance-crop growth models. The complexity of these models depends largely on the time-scale considered. The general principles of modeling growth/yield in relation to water use are presented. Ideally, there should be few enough parameters to be measured, either directly or indirectly, and the crop and the soil system should have an interaction with each other. Once the soil/crop models have been tested with field experiments and parameters have been derived, one may carry out numerical experiments on the computer in order to quickly evaluate the effects of different irrigation management strategies on crop yield. Depending on the environmental conditions, the development of a crop with time will vary from year to year. Crop development usually may be predicted on the basis of temperature (heat sums) and day length. Examples are presented of yield-water use relationships on the basis of a day as well as the entire growing season, and the need for dynamic and interactive crop growth-water balance models is emphasized. (White-Reimer-PTT)
W89-04266

WATER CONVEYANCE IN CHANNELS WITH SEMICIRCULAR CROSS SECTIONS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-04269

OPTIMIZING THE UNIFORMITY OF IRRIGATION AND FERTILIZATION,
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria).
I. Varlev.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 285-296, June 1988. 5 fig, 3 tab, 12 ref.

Descriptors: *Fertilization, *Irrigation efficiency, *Irrigation practices, Furrow irrigation, Sprinkler irrigation, Bulgaria, Mathematical equations, Crop production, Plant growth, Evapotranspiration, Nitrogen compounds.

Using a second-degree equation to approximate the relationship 'water available to the plants-yield', a coefficient of non-uniformity has been derived which is proportional to the yield loss caused by the non-uniformity of irrigation. Using the criterion of the minimum costs and losses, the optimum coefficients of non-uniformity in furrow and sprinkler irrigation have been determined. On this basis, in the case of furrow irrigation, the values of some practically usable indices, such as 'relative extension of irrigation time' and 'required number of streams which must reach the downstream end of furrows' have been determined. Achieving these values in the field will guarantee an optimum irrigation uniformity. In sprinkler irrigation, under the specific economic conditions in Bulgaria, the optimum spacing of sprinklers has been determined for different wind velocities and for two different groups of crops. Under conditions of water shortage, when crops are irrigated only during some selected growth stages, the relationship 'evapotranspiration-yield' is multi-valued. Under these conditions, a considerably higher yield is obtained when water is applied during the most sensitive stages of growth. In that case, the uniformity of irrigation must be as high as possible. When nitrogen fertilizer is broadcast over the soil surface, the loss of yield and the required optimum distance between the runs of the broadcasting implement can be determined, using the coefficient of non-uniformity. (Author's abstract)
W89-04270

CHARACTERISTICS OF MOLE DRAINAGE AS A MAJOR AMELIORATIVE TECHNIQUE FOR SURFACE-WATERLOGGED SOILS,
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria). Dept. of Soil Physics.
N. Shopsky, E. Doneva, and I. Nikolov.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 307-315, June 1988. 3 fig, 4 ref.

Descriptors: *Waterlogging, *Drainage practices, *Mole drainage, *Soil water, *Subsurface drainage, Subsoil drainage, Bulgaria, Soil physical properties, Permeability, Drain spacing, Soil horizons.

The conditions in Bulgaria permit the use of mole drainage as a basic ameliorative technique irrespective of the degree of surface waterlogging, stratification and the main physical properties of the soil. The equation of water-exchange in the filtration area has been used as a basis for describing the filtration and mole draining. It has been found that the depression curve of the steady-state and non-steady-state subsoil flux provides the most adequate characterization of the major processes associated with the drainage of soils which become surface waterlogged because of their having a second horizon (from 20 or 50 cm below the

surface) with low permeability. The roles of the space between drains, the depth of drains and the water permeability of the mole slit have been differentiated and assessed. Mole drainage ought to be made within the upper permeable horizon. In case this is impossible for field management reasons, a part of the mole drain may be burrowed through the second, low-permeable horizon but this penetration should be as small as possible and high geometric and filtration permeability of the mole slit should be ensured, especially of the portion extending into the less permeable horizon. (Author's abstract)
W89-04272

IRRIGATION PROJECT APPRAISAL: OUTLINE OF PRINCIPLES,
Southampton Univ. (England). Inst. of Irrigation Studies.
J. R. Rydzewski.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 359-368, June 1988. 6 ref.

Descriptors: *Project planning, *Irrigation, Economic evaluation, Financial feasibility, Social aspects.

A brief overview is presented of the principles involved in analyzing development projects, with special reference to irrigated agriculture. Project appraisals have two distinct but related functions: to assist the planner-designer in selecting viable project proposals from within a set of technically sound alternatives in a particular sector of the economy; and to allow central planners to make rational decisions between projects in different sectors of the economy, and between mutually exclusive proposals in any given sector. Cost-benefit analyses should include financial, economic and social factors. Financial analysis involves market rates, taxes, subsidies and discount rates; economic or efficiency analysis takes into account economic rate of return as well as non-traded items such as unskilled labor; social analysis is extremely important for less developed countries where the distribution within the entire nation must be considered. An irrigation project can be viewed from the standpoint of the central planning organization, the government or regional socio-political group, the farmers utilizing the project, the management of the public sector projects, and the parties financing the project. Each project will differ in the way it values the inputs and outputs of the project. (White-Reimer-PTT)(Author's abstract)
W89-04275

MODELING DERIVED DEMAND FOR IRRIGATION WATER,
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
For primary bibliographic entry see Field 6D.
W89-04279

EFFECT OF SHELTERBELTS ON GROUNDWATER FORMATION,
All-Union Research Inst. of Agricultural Forest Reclamation, Volgograd (USSR).
For primary bibliographic entry see Field 2F.
W89-04281

ASSESSING STRATEGIES FOR CONTROL OF IRRIGATION-INDUCED SALINITY IN THE UPPER COLORADO RIVER BASIN,
For primary bibliographic entry see Field 5G.
W89-04302

IRRIGATION OPTIMIZATION UNDER LIMITED WATER SUPPLY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
D. J. Bernardo, N. K. Whittlesey, K. E. Saxton, and D. L. Bassett.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 712-719, May-June 1988. 1 fig, 4 tab, 16 ref.

Descriptors: *Irrigation design, *Water supply, *Optimization, *Model studies, *Water conservation, Mathematical models, Economic aspects, Irrigation operation, Yield, Yield equations, Hydrologic budget, Simulation.

A two-stage simulation/mathematical programming model was developed to determine the optimal intraseasonal allocation of irrigation water under conditions of limited water availability. The model was applied to a representative surface irrigated farm in Washington State's Columbia River Basin. Results from applying the model to a series of increasingly severe water shortage conditions indicated a large potential for water conservation in the assumed production setting. Farm-level water supply reduction of 40% translated to about 10% decrease in economic returns. Income losses resulting from water shortages were minimized through the conjunctive management of irrigation scheduling, irrigation labor practices, and several other short-run responses to water deficits. The combination of crop water simulation and farm-level economic optimization models was shown to be a compatible merger of techniques for representing the engineering and economic irrigation environment. (Author's abstract)
W89-04377

SIMULATION OF CORN YIELD BY A WATER MANAGEMENT MODEL FOR A COASTAL PLAIN SOIL IN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
P. C. McMahon, S. Mostaghimi, and F. S. Wright.
Transaction of the ASAE TAAEAJ, Vol. 31, No. 3, p 734-742, May-June 1988. 10 fig, 6 tab, 23 ref.

Descriptors: *Subsurface drainage, *Soil-water-plant relationships, *Simulation, *Model studies, Soils, *Water management, *Virginia, Coastal plains, Water table, System design, Yield equations, Water resources development, Drainage practices, Yield, Corn, Subsurface irrigation, Drain spacing.

DRAINMOD, a water management simulation model for artificially-drained soils, was evaluated for a Virginia Coastal Plain soil by comparing predicted and measured water table depths from a subirrigation/controlled drainage site over a period of three years. Water table evaluations predicted by the model were in good agreement with measured water table elevations, with an average deviation of 9.47 cm for the three years of record. The YIELD version of DRAINMOD was used to predict relative corn yield for the subirrigation/controlled drainage site. Average corn yield predictions by the model agreed reasonably well with the observed average corn yield, with relative errors of 19.2, 4.4, and 8.1 percent for 1984, 1985, and 1986, respectively. Additionally, corn yields predicted for a conventional drainage system were considerably lower than those predicted for subirrigation/controlled drainage, reaffirming the need for irrigation of corn in the Coastal Plain region of Virginia. Research indicates that DRAINMOD is a powerful tool for the design and evaluation of subirrigation/controlled drainage practices in the Virginia Coastal Plain. Simulations were performed for a 20 year period to determine the effects of system design on corn yield. An economic analysis was performed to determine optimal system design for maximizing profits from corn production. A drain spacing of 21.30 m, a drain depth of 1.10 m, and a 0.65 m weir depth were the design parameters recommended as optimal for maximizing profits from subirrigation/controlled drainage of corn on a Myatt fine sandy loam in the Virginia Coastal Plain. (Author's abstract)
W89-04378

ANALYTICAL TRANSIENT EQUATIONS FOR DRAINS IN ARTESIAN AREAS,
Ministry of Irrigation, Cairo (Egypt).
M. S. Abdel-Dayem, A. S. Bazaraa, A. M. Amer, and L. S. Willardson.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 743-749, May-June 1988. 13 fig, 8 ref, append.

Descriptors: *Subsurface drainage, *Drain spacing, *Confined groundwater, *Model studies, *Mathematical equations, Mathematical analysis, Drainage effects, Water table fluctuations, Seepage, Water table decline, Optimization, Drains, Drawdown, Piezometric head, Hydraulic conductivity.

A transient solution for a falling water table above drains in irrigated areas subject to artesian conditions was developed. The solution determines the water table height midway between the drains the corresponding drain discharge and the fraction of drain discharge originating from the aquifer. The transient solution for the falling water table was verified against experimental results obtained from a Hele-Shaw model. Satisfactory agreement between analytical and experimental results was found over a reasonable and practical range of flow conditions. The rate of water table drawdown strongly depends on the piezometric head in the aquifer and the depth of the soil layer between the drains and the aquifer. It also depends on the soil layer hydraulic conductivity and drainable porosity. The water table drawdown also depends on the drain size. (Author's abstract)
W89-04379

MECHANISMS BY WHICH SURGE IRRIGATION REDUCES FURROW INFILTRATION RATES IN A SILTY LOAM SOIL,
Agricultural Research Service, Kimberly, ID.
W. D. Kemper, T. J. Trout, A. S. Humphreys, and M. S. Bullock.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 821-829, May-June 1988. 9 fig, 2 tab, 25 ref.

Descriptors: *Furrow irrigation, *Border irrigation, *Infiltration rate, *Soil types, *Soil water, Irrigation, Furrows, Silty loam, Soil water, Sediments, Suspended sediments, Deposition.

Surge irrigation, the intermittent supply of water to furrows or borders, generally reduces infiltration rates. However, the degree of infiltration reduction is variable and difficult to predict. Mechanisms by which surge irrigation reduces infiltration rates include: (1) Consolidation of the furrow perimeter due to increased soil water tension during flow interruptions, (2) Filling of cracks which develop during flow interruptions with bed load during the following surge, (3) Forced settlement of suspended sediment on the furrow perimeter when the water supply is interrupted, and (4) Greater sediment detachment and movement caused by more rapid advance of the surged stream front. (Author's abstract)
W89-04386

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ASSESSMENT OF THE ROLE OF BOTTOMLAND HARDWOODS IN SEDIMENT AND EROSION CONTROL.
Fish and Wildlife Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W89-03351

STORMWATER MANAGEMENT IN AN URBANIZED AREA,
STS Consultants Ltd., Northbrook, IL.
W. J. Weaver.
Public Works PUWOAH, Vol. 119, No. 11, p 60-62, October 1988.

Descriptors: *Urban runoff, *Storm water, *Illinois, *Storm drains, *Watershed management, Settling basins, Management planning, Urban areas, Land use, Cost analysis.

Stormwater management in the Hesterman Watershed, Illinois, which was subjected to rapid urbanization during the 1970's, is discussed. Resolution of flooding problems in the Hesterman Watershed required creativity in design, financing, and implementation. The development of the watershed

began in 1967 with the construction of a 300-acre facility for AT and T Bell Laboratories. Stormwater management regulations applied by Naperville and DuPage County were restrictive and required that stormwater runoff from the developed parcel of land not be increased over predevelopment conditions. Bell constructed an extensive retention pond system to meet the local criterion. The retention system outlet was connected to the 21-inch diameter drain tile, which passed through the property and was the only available regional storm drain. After the completion of the residential section of the watershed, flooding in the area prompted an engineering study which pointed to several problems. The focusing of stormwater at a point dramatically changed the runoff character. No master plan was in place that new developments could use as a guideline for stormwater management. The design criteria for solving the problems of the watershed included: resolving residential area flooding; reducing the duration and extent of golf course flooding; maximizing and optimizing storage of stormwater on Forest Preserve District properties; maintaining the capacity of the Bell stormwater management system; and not increasing downstream flooding on Rott Creek. An engineering committee was established to formulate cost-effective solutions to the flooding problems. A regional stormwater drainage system was developed for the watershed which consisted of a gravity flow portion and a pressurized storm sewer with several branches. The new stormwater management system interconnects seven lakes, retention ponds, and wetland areas that were previously connected to the drain tile. The various branches of the regional storm sewer system were sized to flow under pressure such that the total discharge from the system would be regulated. The successful financing strategy for the project is discussed. (Geiger-PTT)
W89-03449

ENVIRONMENTAL EFFECTS OF THE HIGH DAM AT ASWAN,
Colorado Univ., Boulder. Inst. of Behavioral Science.
For primary bibliographic entry see Field 6G.
W89-03538

FLOOD CONTROL OF URBAN RUNOFF IN THE EAST AREA OF OSAKA PREFECTURE (NEYA RIVER BASIN),
Osaka Prefecture Sewerage Div. (Japan).
K. Kitai.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 207-234. 17 fig, 13 tab.

Descriptors: *Japan, *Model studies, *Urban runoff, *Flood control, *Flood damage, Simulated rainfall, Rainwater runoff, Runoff control, Wastewater treatment, River conservation.

The eastern part of Osaka Prefecture, comprising the Neya Basin, is a low-lying area which has suffered flood damage since ancient times. Though damage has been gradually reduced due to sewerage construction and river improvement, the recent rapid urbanization of this region has increased rainwater runoff from the region. A rainwater runoff model using the Espey Model with an increased run-off coefficient was designed. It proved that the pump and pipe capacity is now insufficient due to the increase in peak discharges. In addition, calculations revealed the possibility of overflow on a fairly large scale. Osaka Prefecture plans to solve these problems by improving discharge capacity, as well as by constructing storage facilities for sewerage pipes, which may prove to be a more efficient measure. It is also expected that the runoff load during rainfall will be greatly reduced by means of these facilities. The Comprehensive Flood Disaster Prevention Plan for the region covering sewerage, river improvement and facilities for runoff control is now under preparation. This plan will coordinate related sections by assigning clearly-defined tasks to each of them, and enhance safety precautions against flooding in the Neya Basin. (See also W89-3657) (Author's abstract)
W89-03665

ELEMENTS OF FLOATING-DEBRIS CONTROL SYSTEMS,
Cold Regions Research and Engineering Lab., Hanover, NH.
R. E. Perham.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A200454. Price codes: A04 in paper copy; A01 in microfiche. Technical Report REMR-HY-3, September 1988. Final Report. 67p, 35 fig, 34 ref, 2 append.

Descriptors: *Detritus, *Surface waters, *Cleanup operations, Booms, Water pollution treatment.

Floating debris is a continual problem for all users of water bodies. Some of the damage caused by debris is minor, but too often it is quite costly. It is destructive to locks, dams, bridges, electric plants, municipal water systems, and even to recreational boaters. Wetlands, fish-spawning grounds, and streambanks can be disturbed by debris. A floating-debris control system consists of collecting, removing, and disposing of the debris. Various types of booms, trash racks, trash struts, and deflectors have been used effectively for collecting floating debris. Hand-powered, self-powered, and gantry crane-operated rakes are used to remove the debris from intake gates, bulkheads, deck gratings, and trash rack sections. Heavy debris, such as water-soaked logs or fallen trees, are removed with cranes and hoists, supplemented by such implements as bolt hooks, log chains, and chain saws. Some of the removed debris has value. Many logs are large enough to be used as structural materials: supports for small buildings, guard posts for parking lots, and supports for soil stabilization. Also, some of it can be dried and cut up for firewood. The debris that cannot be used must be burned, buried, or dumped on the ground surface. All of these processes require careful monitoring so that they are not and do not create health hazards. Surface dumping should be used only as a last resort. (Lantz-PTT)
W89-03769

DEPENDABLE YIELD EVALUATIONS: HOW MUCH WATER IS REALLY THERE,
Black and Veatch, Kansas City, MO.
R. L. Smith, and L. K. Lampe.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 66-70, September 1988. 3 fig, 2 tab, 8 ref.

Descriptors: *Water yield, *Reservoir yield, *Water management, *Water supply, Management planning, Evaluation.

The yield capability of most surface water impoundments is tested infrequently. A number of factors, including issues related to hydrologic uncertainty, changing physical use and sedimentation patterns, and evolving legal constraints, may have altered the yield capability of a surface impoundment since its last appraisal, particularly if the yield estimate was made 20 or 30 years ago. The yield value, however determined, is based on a critical period, sometimes lasting no longer than six months. For utilities in many parts of the country, these critical periods include the months of May to October when actual demand rates are typically 20 percent greater than the average annual rates. During drought years this differential may be and usually is, even larger. Factors affecting inflow volumes, storage, and outflow are discussed, as well as some case examples. Managers should make sure that the appraisal of dependable yield for surface water impoundments is periodically updated. (VerNooy-PTT)
W89-03877

HYDROCHEMICAL STUDY OF URBAN LANDSLIDES CAUSED BY HEAVY RAIN: SCARBOROUGH BLUFFS, ONTARIO, CANADA,
Scarborough Coll., Westhill (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-03970

FLOOD OF APRIL 1987 IN MAINE, MASSACHUSETTS, AND NEW HAMPSHIRE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04050

FLOODS IN EASTERN NEBRASKA AND SOUTHEASTERN SOUTH DAKOTA, JUNE 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04059

STREAMFLOW CHARACTERISTICS OF THE GREEN, BEAR, AND SNAKE RIVER BASINS, WYOMING, THROUGH 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04118

FLOODS OF OCTOBER 1986 IN SOUTH-CENTRAL ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04122

FLOODS IN IOWA: STAGE AND DISCHARGE,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04131

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1985 - NOVEMBER 30, 1986,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 3D.
W89-04133

ANNUAL PEAK DISCHARGES AND STAGES THROUGH 1984 FOR GAGING STATIONS IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04145

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1984 - NOVEMBER 30, 1985,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 3D.
W89-04152

STREAMFLOW CHARACTERISTICS OF THE COLORADO RIVER BASIN IN UTAH THROUGH SEPTEMBER 1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04160

POTENTIAL FLOOD AND DEBRIS HAZARDS AT KATHERINE LANDING AND TELEPHONE COVE, LAKE MEAD NATIONAL RECREATION AREA, MOHAVE COUNTY, ARIZONA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04165

Group 4A—Control Of Water On The Surface

FLOOD-CARRYING CAPACITIES AND CHANGES IN CHANNELS OF THE LOWER PUYALLUP, WHITE, AND CARBON RIVERS IN WESTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
E. A. Prych.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4129, 1988. 69p, 13 fig, 9 tab, 8 ref.

Descriptors: *Flood profiles, *Sedimentation, *Vegetation effects, *Washington Puyallup River Basin, Puyallup River, White River, Carbon River, Flood-carrying capacity.

The flood-carrying capacity of the Puyallup River's leveed channel from its mouth to the city of Puyallup exceeds the 100-yr-flood discharge at most locations. Upstream from the city of Puyallup the flood-carrying capacity also is less than the 100-yr flood at many locations. In King County the flood-carrying capacity would be greater than the 100-year flood nearly everywhere if the levees were in a good state of repair. The flood-carrying capacity of the leveed Carbon River channel is less than the 100-yr flood at numerous locations. Changes between 1976-77 and 1984 in average channel cross-section elevations for the Puyallup and Carbon Rivers were less than 1 ft at more than one-half of 90 surveyed cross sections and were more than 2 ft at only 5 of them. Changes in average elevations for the White River downstream of the inflow from Lake Tapps rose approximately 2 ft or more at 5 of the 10 surveyed cross sections, but decreased 2 ft or more at nearly one-half of 29 cross sections upstream of the reach. Differences between computed 100-yr floodwater-surface elevations for 1976-77 and 1984 channels are similar to changes in average cross-section elevations. Dense growths of streambank vegetation could increase 100-yr floodwater surface elevations by 1.2 ft. (USGS)
W89-04166

ESTIMATING FLOOD HYDROGRAPHS AND VOLUMES FOR ALABAMA STREAMS,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04168

CHANNEL INFILTRATION ALONG THE PAWNEE RIVER AND ITS TRIBUTARIES, WEST CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04169

STREAMFLOW CHARACTERISTICS OF THE MISSOURI RIVER BASIN, WYOMING, THROUGH 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04170

EXPERIENCE IN USING THE WATER RESOURCES OF THE NOVOSIBIRSK RESERVOIR,
For primary bibliographic entry see Field 6D.
W89-04194

MACDRAIN: A SURVEYING, MAPPING, AND DRAINAGE DESIGN SYSTEM FOR THE MICROCOMPUTER,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W89-04214

UNCERTAINTY ESTIMATES FOR SURFACE RUNOFF MODELS,
Williamson and Schmid, Irvine, CA.
For primary bibliographic entry see Field 2E.
W89-04240

CONJUNCTIVE USE OF WATER FOR IRRIGATION, MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN ISTRA, YUGOSLAVIA,
Rijeka Univ. (Yugoslavia). Faculty of Civil Engineering.
For primary bibliographic entry see Field 6D.
W89-04264

EFFECT OF DIFFERENT PARAMETERS ON ENTRANCE RESISTANCE OF CORRUGATED PLASTIC DRAINS,
Ministry of Public Works, Salonika (Greece).
For primary bibliographic entry see Field 8B.
W89-04265

SINKHOLE MANAGEMENT AND FLOODING IN JAMAICA,
World Meteorological Organization, Kingston (Jamaica).
M. Molina, and F. McDonald.
Environmental Geology and Water Sciences EGWSEI, Vol. 12, No. 2, p 113-116, August 1988. 1 fig, 2 tab, 4 ref.

Descriptors: *Karst hydrology, *Flooding, *Karst, *Jamaica, *Flood control, *Watershed management, Sinkhole management, Rainfall, Geology, Hydrology, Cave River Basin, Hydraulics, Nonstructural alternatives, Civil defense.

More than 518 sq km of prime lands in Jamaica lay on Karstic material where sinkholes are the natural outlet of important streams. Due to increasing social pressure, the lands are inappropriately managed and as a consequence, vegetal debris and silting have plugged the sinkholes which have thus lost their capacity to drain the runoff produced during heavy rainfall. One of these areas is Cave Valley, which during the last 36 yr, has been affected by at aleast six floods, some of which have produced losses of life and property, in a sector of the Jamaican population which is already under severe economic hardship. A flood prevention and mitigation project is being implemented including watershed management, river training and community preparedness. A geologic, hydrologic, and hydraulic analysis are also part of the study. All these measures are expected to reduce future losses. (Author's abstract)
W89-04325

4B. Groundwater Management

IMPROVED ESTIMATES OF GROUNDWATER-MINING ACREAGE,
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 2F.
W89-03420

CLEAN WATER SUPPLY DEPENDS ON MANAGEMENT OF GROUNDWATER,
Greeley and Hansen, Chicago, IL.
For primary bibliographic entry see Field 5G.
W89-03492

WATER MANAGEMENT AND PROTECTION IN OPENCAST MINING REGIONS AND UTILIZATION OF MINE WATER.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-900395. Price codes: A02 in paper copy, A01 in microfiche. Report No. COAL:/GE--5/R-37/Add.9, November 12, 1987. 9p, 1 tab.

Descriptors: *Groundwater management, *Mine drainage, *Water quality management, *Strip mines, *Mine water, *Impaired water use, Water analysis, Hydrogen ion concentration, Water quality.

The brown-coal deposits in the German Democratic Republic are mainly located in the south of the country, and are mostly of autocthonous origin. The opencast pits or brown-coal deposits are within the catchment areas of: Lausitzer Neisse; Kleine and Grosse Spree; Schwarze and Weisse Elster; Zwichauer Mulde; and the Eaale. There are only a few large lakes or reservoirs in the opencast mining areas. Opencast pits are dewatered exclusively through gravity drainage, the predominant technique being the use of dewatering boreholes. The perforated and solid-wall pipes used in the boreholes have an internal diameter of 250 m. The water raised to the surface by means of submersible pumps with submersible motors is directed into a collector (pressure or non-pressure pipeline, drainage ditch) and carried to a groundwater treatment plant or directly to the drainage system or to a user (for example, to a waterworks). The total volume of water brought to the surface in 1985 amounted to approximately 1.8 billion cu m. The mine water raised to the surface is generally delivered to the user or to the drainage system in blended form, with the following quality characteristics: pH 3.8-7.8; total hardness of 5-25 degrees; total iron content, 2-100 mg/L; and suspended solids, 5-80 mg/L. Mine water is then further purified and used for a variety of purposes including: industry, agriculture, and public reservoirs. (Lantz-PTT)
W89-03752

HYDROLOGY OF A STREAM-AQUIFER SYSTEM IN THE CAMP VERDE AREA, YAVAPAI COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-03773

GROUND-WATER RESOURCES OF THE FORT BELKNAP INDIAN RESERVATION, NORTH-CENTRAL MONTANA: POTENTIAL SOURCES OF GROUND WATER FOR IRRIGATION, DOMESTIC AND MUNICIPAL SUPPLY,
Geological Survey, Billings, MT.
R. D. Feltis.
Montana Bureau of Mines and Geology Memoir 53, 1983. 36p, 12 fig, 6 tab, 13 ref, 2 append.

Descriptors: *Data collections, *Hydrologic data, *Water resources, *Groundwater supply, *Fort Belknap, *Montana, Irrigation, Aquifers, Dissolved solids, Calcium sulfate, Water use, Competing use, Wells, Drinking water, Water quality, Domestic water, Municipal water.

Water of suitable quality for irrigation on the Fort Belknap Indian Reservation is available from Quaternary alluvium beneath valleys adjacent to the Little Rocky Mountains. The supply is limited, however, and the hydrology is relatively unknown. Alluvium beneath valleys farther removed from the mountains also yields water to wells, but the chemical quality of the water may be unsuitable for irrigation. Water for irrigation also is available from the cavernous limestone of the Madison Group of Mississippian age. Water discharged from the Madison at Big Warm Spring in the Little Rocky Mountains is a calcium sulfate type having a range in dissolved solids concentration of 1,100 to 1,500 mg/L. Water from a well completed in the Madison at the north end of the Reservation is a sodium sulfate type containing 1,690 mg/L dissolved solids. Test wells drilled through the Madison would range in depth from 3,470 to 4,810 feet, depending upon the geologic setting at the well sites. The potentiometric surface of water in the Madison is above land surface over most of the Reservation; therefore, wells would flow in most areas. Water for domestic and municipal supply is available from alluvium of valleys adjacent to the Little Rocky Mountains. Wells for domestic supply have been drilled into bedrock formations that dip into the plains from the mountains. Some wells yield usable water but others yield unpotable water. A well-planned test-drilling program would provide a better understanding of the hydrologic characteristics of the aquifers. Test wells would provide information needed to determine the availability, extent and areal chemical quality of water in alluvium and bedrock formations. (Author's abstract)
W89-03778

GLEAMS: GROUNDWATER LOADING EFFECTS OF AGRICULTURAL MANAGEMENT SYSTEMS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W89-03834

GROUNDWATER LEVEL DATA FOR THE ALBUQUERQUE-BELEN BASIN, NEW MEXICO THROUGH WATER YEAR 1985,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04071

BEDROCK AQUIFERS IN THE DENVER BASIN, COLORADO - A QUANTITATIVE WATER RESOURCES APPRAISAL,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04076

HYDROGEOLOGY OF THE CAMBRIAN-ORDOVICIAN AQUIFER SYSTEM AT A TEST WELL IN NORTHEASTERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04110

COMPILATION AND ESTIMATION OF PUMPAGE FOR THE MAJOR GROUNDWATER USERS IN THE COASTAL PLAIN OF ALABAMA, 1960-85,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-04153

PROPOSED WORK PLAN FOR THE STUDY OF HYDROLOGIC IMPACTS OF GROUNDWATER DEVELOPMENT IN THE WET MOUNTAIN VALLEY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04162

WATER RESOURCES OF OLEY TOWNSHIP, BERKS COUNTY, PENNSYLVANIA,
Geological Survey, Dover, DE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04164

SEMI ANALYTICAL SOLUTION FOR THE GROUNDWATER MOUND PROBLEM,
Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Mathematik und Informatik.
For primary bibliographic entry see Field 2F.
W89-04242

HYDROGEOLOGY AND AQUIFER SIMULATION OF THE BASEMENT ROCKS OF THE KADUNA-ZAIRIA AREA, NORTHERN NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Geology.
E. A. Adanu, and M. Schneider.
Advances in Water Resources AWREDI, Vol. 11, p 44-47, March 1988. 5 fig, 6 ref.

Descriptors: *Geohydrology, *Aquifer characteristics, *Bedrock, *Nigeria, *Groundwater porential, Simulation, Semiarid climates, Geologic fractures, Laterites, Porosity, Permeability, Groundwater recharge, Pumping tests, Water supply development, Hydrologic maps, Hydrologic data collections, Computer models, Finite element method, Developing countries.

The study area is situated in the central-northern part of Nigeria, which has a semiarid climate. The aquifer consists of weathered and fractured basement rocks, mainly covered with lateritic soil. For rural water-supply purposes, more than 40 wells were drilled in an area of about 2500 square km. Field-checked interpretation of pumping tests, geophysical data, and soil investigations led to a fairly-precise description of the hydrogeologic situation in the study area. Groundwater occurs in the weathered basement zone. Pumping-test data confirm that porosity and permeability are usually greatly reduced in these formations. Diffuse recharge through the weathered zone exists at a low rate. The aquifer is also recharged through fractures but, on the basis of geologic and tectonic studies, it is assumed that this mechanism is not dominant. Recharge conditions were simulated by application of a simplified finite-element steady-state groundwater-flow model conducted on microcomputer-based systems. The model includes a program which solves the nonstationary-flow equation by the Galerkin method, using the Gauss/Seidel algorithm; the same program can be used for stationary-flow calculation by setting all storage coefficients to zero and by equating time step with time level. The use of the microcomputer in hydrogeologic data management and groundwater-flow modeling proved to be very helpful. (Shidler-PTT)
W89-04244

WATER MANAGEMENT PLAN FOR THE AL-HASSA IRRIGATION AND DRAINAGE PROJECT IN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 3F.
W89-04262

CONJUNCTIVE USE OF WATER FOR IRRIGATION, MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN ISTRA, YUGOSLAVIA,
Rijeka Univ. (Yugoslavia). Faculty of Civil Engineering.
For primary bibliographic entry see Field 6D.
W89-04264

CHARACTERISTICS OF MOLE DRAINAGE AS A MAJOR AMELIORATIVE TECHNIQUE FOR SURFACE-WATERLOGGED SOILS,
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria). Dept. of Soil Physics.
For primary bibliographic entry see Field 3F.
W89-04272

EXTERNALITY AND EQUITY IMPLICATIONS OF PRIVATE EXPLOITATION OF GROUND-WATER RESOURCES,
Institute of Rural Management, Anand (India).
For primary bibliographic entry see Field 6E.
W89-04303

GROUNDWATER RESOURCES IN THE NORTH CHINA PLAIN,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2F.
W89-04324

4C. Effects On Water Of Man's Non-Water Activities

CAUSES OF WETLAND LOSS IN THE COASTAL CENTRAL GULF OF MEXICO. VOLUME I: EXECUTIVE SUMMARY.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W89-03357

EXPERIMENTAL STUDIES ON SOME FACTORS INFLUENCING PHOSPHORUS SOLUBILIZATION IN CONNEXION WITH THE DRAWDOWN OF A RESERVOIR,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2H.
W89-03557

STATISTICAL METHODS FOR A REGIONAL GROUND-WATER QUALITY APPRAISAL IN DIFFERENT LAND-USE AREAS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. A. Eckhardt, and D. R. Helsel.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 5-7.

Descriptors: *Long Island, *New York, *Groundwater quality, *Land use, *Water quality, *Water pollution source, Wells, Organic compounds, Statistical methods, Pesticides, Regression analysis, Groundwater, Agricultural hydrology, Model studies.

Water quality data from 90 shallow wells screened in the upper glacial aquifer beneath different land-use areas in Nassau and Suffolk Counties, Long Island, were compared to assess the effects of human activities and land-use practices on groundwater quality. Volatile organic compounds, semi-volatile organic compounds, major and trace inorganics, and five pesticide groups were analyzed. Statistical methods used were applicable to the skewed and censored distributions typical of water quality data: (1) exploratory data analysis, primarily boxplots and scatterplots, (2) nonparametric procedures comparing ranks of concentrations within and among land-use groups, (4) contingency-table analyses comparing detection frequencies among land-use groups, and (4) logistic regression analysis. Predictive logistic regression models of the probability of contaminant occurrence in shallow groundwater under the entire two county area were developed from explanatory variables such as population density. Recent water quality data from more than 300 wells then verified the predicted probability of contamination at each well. Comparison of the data indicates that samples from the undeveloped area have the lowest and least variable concentrations for all constituents. Inorganic-constituent concentrations for samples from the three suburban areas were generally intermediate to high whereas concentrations from the agricultural area were generally highest and most variable. (See also W89-03595) (Miller-PTT)
W89-03596

STATISTICAL COMPARISONS OF GROUNDWATER QUALITY UNDERLYING DIFFERENT LAND USES IN CENTRAL FLORIDA,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 7C.
W89-03602

ENGINEERING AND ENVIRONMENTAL GEOLOGY OF THE INDIAN WELLS VALLEY AREA,
Naval Weapons Center, China Lake, CA.
J. T. Zellmer.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 288. Price codes: A03 in paper copy, A01 in microfiche. Report No. NWC TP 6854, November 1987. 37p, 7 fig, 54 ref.

Descriptors: *Seismic hazards, *Hazardous materials, *Waste disposal, *Geohydrology, *Indian wells Valley, *Seismology, *Water management, California, Groundwater supply, Management planning, Geophysics, Public relations.

The Indian Wells Valley (IWV) area of southeastern California, is affected by several geologic and geotechnical hazards and problems. These include seismic activity, a limited groundwater resource, flooding, poor soil conditions, slope instability, liquefaction susceptibility, a locally high groundwater table, sewage and toxic waste disposal, and the

potential for volcanic activity. Many of the present difficulties are directly or indirectly related to the rapid wartime building of the Naval Ordnance Test Station (now Naval Weapons Center), China Lake, during which adequate consideration was not always given to the geologic and geotechnical factors that affect the local area and region. Now that various problems and hazards have been recognized, efforts are under way to mitigate the deleterious effects of past actions and decisions and to prevent their recurrence. A major factor in these efforts is the increasing involvement of geologic and geotechnical data and expertise in decision-making. In the long-term, the most serious problems to affect this area will be an adequate water supply and the effects of seismic activity. The mitigation of these problems and earthquake hazards must be treated through public awareness and governmental action such as zoning and site investigation requirements. Moderate to great earthquakes are inevitable in this region and their effects must be addressed. Recognizing this necessity, NWC provided funds for the mapping of active faults, seismicity studies, liquefaction susceptibility studies, and for obtaining other critical geologic and geotechnical information. These data, in combination with public awareness, have resulted in major advances in seismic-hazard mitigation efforts in the private and public sectors. (Lantz-PTT)
W89-03742

GLEAMS: GROUNDWATER LOADING EFFECTS OF AGRICULTURAL MANAGEMENT SYSTEMS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W89-03834

VARIABILITY IN THE DISTRIBUTION OF LATE-STAGE OYSTER LARVAE IN THE CALCASIEU ESTUARY,
McNeese State Univ., Lake Charles, LA. Dept. of Biological and Environmental Sciences.
M. Vecchione.
Contributions in Marine Science, Vol. 30, p 77-90, December 1987. 2 fig, 7 tab, 36 ref. Office of Coastal Zone Management, Coastal Energy Impact Program Grant Na-83-AA-D-CZ025.

Descriptors: *Navigation, *Larvae, *Oysters, *Estuaries, *Population dynamics, Spatial distribution, Temporal distribution, Aquatic populations, Seasonal variation, Bayous.

The Calcasieu Estuary is the largest body of water in southwest Louisiana and it has been subjected to substantial man-made perturbations. Oyster larvae (Crassostrea virginica) were collected in this estuary by net sampling over a four-year period to examine several scales of spatial and temporal variability. The dominant pattern in these data was high variability in replicate collections, perhaps indicating aggregation on a scale of tens of meters. Some patterns were discernible because a large data set was assembled. The highest concentrations of late-stage larvae tended to be near the mouth of the estuary. The larvae were rare in the West Cove area, which is hydrodynamically distinct from the rest of the estuary. Both the eastern part of Calcasieu Lake and the bayous of the upper Calcasieu Estuary appeared to be provided seasonally with a reasonable supply of larval oysters. The strongly bimodal seasonality (spring and autumn) of late-stage oyster larvae may be subject to interannual variability on a scale which is presently unpredictable. (Author's abstract)
W89-03853

POST-1847 CHANGES IN THE AVON-HEATHCOTE ESTUARY, CHRISTCHURCH: A STUDY OF THE EFFECT OF URBAN DEVELOPMENT AROUND A TIDAL ESTUARY,
Christchurch City Engineer's Dept. (New Zealand).
R. H. Findlay, and R. M. Kirk.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 1, p 101-127, 1988. 20 fig, 2 tab, 17 ref, 2 append.

Descriptors: *Urbanization, *Geomorphology, *Estuaries, *New Zealand, *History, *Tidal effects, Urban planning, Coastal zone management, Geologic mapping, Inlets, Beach erosion.

A detailed, history of changes to the Avon-Heathcote Estuary mouth at Christchurch, New Zealand, is presented. Between 1847 and 1911 the estuary inlet was dominated by a tidal bypassing regime. Between 1911 and 1938 this changed to a mixed tidal and bar bypassing regime, with consequent erosion of the tip of the South Brighton Spit, probably permanent loss of sand from Sumner Beach, and increased vulnerability to erosion of properties in the suburb of Redcliffs. The change is thought to be related to changes in estuarine tidal compartment owing to the pre-1920-1940 urbanization of the Christchurch area. The change in estuary inlet regime, especially in the context of the post-1946 residential development of Brighton Spit, has important implications for town planning. (Author's abstract)
W89-03860

POVERTY BAY, NEW ZEALAND: A CASE OF COASTAL ACCRETION 1886-1975,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2L.
W89-03862

GAS DIFFUSION, FLUID FLOW AND DERIVED PORE CONTINUITY INDICES IN RELATION TO VEHICLE TRAFFIC AND TILLAGE,
Scottish Inst. of Agricultural Engineering, Penicuik.
For primary bibliographic entry see Field 2G.
W89-03915

VARIATION OF WATER YIELD FROM CATCHMENTS UNDER INTRODUCED PASTURE GRASS AND EXOTIC FOREST, EAST OTAGO,
Ministry of Works and Development, Dunedin (New Zealand).
P. J. T. Smith.
Journal of Hydrology JHYDA7, Vol. 26, No. 2, p 175-184, 1987. 7 fig, 4 tab, 16 ref.

Descriptors: *Forest hydrology, *Grassed waterways, *Rainfall-runoff relationships, *Water yield, *River flow, Land use, Rainfall, Vegetation establishment, Meterology, Hydrographs, Storm runoff, Flow deviation, Catchment areas, Rivers, New Zealand, Recession curve.

Eight years' data from four catchments in East Otago, New Zealand, two under introduced grass cover and two under exotic forest cover, were analyzed for net differences in annual yields, quickflow volumes, delayed flow and recessions. Pasture catchments consistently yielded more water in all facets of the flow regime when compared to exotic forest catchments. Even for storm with high return periods (up to 100 years) causing simultaneous rainfall over all catchments, the forest catchments yielded less runoff. Recession curves of all catchments showed similar characteristics, but grass catchments consistently yielded more water during recession periods because they always commenced at higher discharges. (Author's abstract)
W89-03967

COMPARATIVE STUDY OF THE FISH COMMUNITIES OF TWO NIGERIAN HEADWATER STREAMS IN RELATION TO MAN-MADE PERTURBATIONS,
Cross River State Univ., Uyo (Nigeria). Dept. of Zoology and Fisheries.
O. M. Udoidiong.
Biological Conservation BIOCOK, Vol. 45, No. 2, p 93-108, 1988. 5 fig, 3 tab, 17 ref.

Descriptors: *Nigeria, *Headwaters, *Streams, *Fish, *Species composition, *Ecological effects, Land use, Water pollution effects, Pesticides, Piscicides, Water quality, Populations, Fish populations, Ecology, Erosion, Agriculture.

Small streams in southeastern Nigeria support a rich and varied freshwater fish fauna, but scientific reports on them are lacking. Two headwater (first-order) streams and their fish assemblages were surveyed in this locality, and the results indicate high similarity in fish species composition, but differences in other community parameters. Whereas three species were dominant and 14 rare in the Udom stream, four species (three different) were dominant and 15 rare in the Nung Oku stream, in contrast to an earlier report that first-order streams have a fish community composed of one rare and one common species. The effects of land use and irrational exploitation on these streams are discussed and the need for conservation stressed. The results indicate that these small inland waters are sensitive to man-made perturbations. (Author's abstract)
W89-03992

PROGRESS REPORT ON THE GROUNDWATER, SURFACE WATER, AND QUALITY-OF-WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA-1987-88,
Geological Survey, Flagstaff, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04029

HYDRAULIC AND CHANNEL CHARACTERISTICS OF SELECTED STREAMS IN THE KANTISHNA HILLS AREA, DENALI NATIONAL PARK AND PRESERVE, ALASKA, 1982-84,
Geological Survey, Anchorage, AK. Water Resources Div.
J. L. Van Maanen, and G. L. Solin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-325, 1988. 105p, 101 fig, 44 tab, 3 ref.

Descriptors: *Placer mining, *Channel morphology, *Sedimentation, *Alaska, Sediment transport, Erosion, Deposition, Streamflow, Denali National Park.

The Kantishna Hills area of the Denali National Park and Preserve contains extensive placer gold deposits. In order to develop plans for management of this natural resource, and to assess the effects of placer mining on aquatic systems, a documentation of the physical characteristics of the streams in the area was needed. Channel morphology, streamflow, and streambed composition data were collected at 14 stream reaches in the Kantishna Hills area in September 1982 and in June, July, August, and September 1983 and 1984. The reaches selected include locations of historical and current mining activity and locations which are undisturbed. The data indicate only minor differences in the physical properties of the streams in mined and unmined drainage basins. Changes which could be directly attributed to mining activity were noted only at Rainy Creek where the stream had been diverted from its natural channel by the construction of settling ponds. (USGS)
W89-04033

RAINFALL AND RUNOFF QUANTITY AND QUALITY CHARACTERISTICS OF FOUR URBAN LAND-USE CATCHMENTS IN FRESNO, CALIFORNIA, OCTOBER 1981 TO APRIL 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04064

RAINFALL AND RUNOFF QUANTITY AND QUALITY DATA COLLECTED AT FOUR URBAN LAND-USE CATCHMENTS IN FRESNO, CALIFORNIA: OCTOBER 1981 - APRIL 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04065

HYDROLOGY OF AREA 57, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, UTAH AND ARIZONA,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-068, 1987. 63p, 57 fig, 8 tab, 75 ref.

Descriptors: *Water resources, *Groundwater, *Surface water, *Water quality, *Geohydrology, *Utah, *Hydrologic impacts, Coal mines, Environmental impact, Arizona, Colorado River Basin, Sevier River Basin, Virgin River Basin.

Some of the hydrologic impacts that could result from large-scale mining of the coal in area 57, Utah and Arizona are described. Of particular concern are impacts on existing water rights and on water quality (including fluvial sediment and salinity in the Colorado River). Area 57 includes about 9,000 sq mi in south-central Utah and north-central Arizona. About 75% of the area is in the Colorado River Basin and the remaining 25% is in the Great Basin. All of the area's coal is in Utah, mostly in the Kolob, Alton, and Kaiparowits Plateau coal fields. The area is characterized by a series of progressively higher benches, terraces, and plateaus that have been dissected by deep, narrow canyons. Altitudes in the area vary from less than 3,000 to more than 11,000 ft, and local relief is more than 1,000 ft. Rocks ranging in age from Permian to Quaternary are exposed in the area. The principal coal-bearing formations are the Dakota and Straight Cliffs Sandstones and Tropic Shale, all of Cretaceous age. Normal annual precipitation in the area varies from about 6 to 40 inches. Estimated mean annual runoff varies from less than 1 to more than 10 inches. Dissolved-solids concentrations of surface water generally are less than 300 mg/l in the higher altitudes but increase to locally more than 3,000 mg/l in the lower altitudes. Estimated annual sediment yields vary from less than 0.1 to more than 3 acre-ft/sq mi, and suspended-sediment concentrations locally exceed 100,000 mg/l during flood runoff. Potential yields of individual wells generally are less than 50 gal/min in most of the area, but locally they exceed 1,000 gal/min. The largest well yields are from unconsolidated deposits of Quaternary age in Cedar and Parowan Valleys and from Navajo Sandstone of Jurassic and Triassic age. Dissolved-solids concentrations of groundwater in the area range from less than 500 to nearly 10,000 mg/l depending largely on geologic source. Some of the coal in Area 57 is available by surface mining; very little of the coal has been mined as of 1983. (USGS)
W89-04066

HYDROLOGY OF AREA 51, ROCKY MOUNTAIN COAL PROVINCE, WYOMING AND MONTANA,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-734, 1987. 73p, 61 fig, 10 tab, 68 ref.

Descriptors: *Hydrologic data, *Watersheds, *Environmental effects, *Coal hydrology, *Wyoming, *Montana, *Bighorn River, *Wind River, *Fort Union Formation, Streamflow, Floods, Water quality, Dissolved solids, Suspended sediments, Aquifers, Groundwater, Aquatic environment, Mesaverde Formation, Energy development.

This report is one of a series designed to characterize the hydrology of drainage basins within coal provinces, nationwide. Area 51 (in the Rocky Mountain Coal Province) includes all or part of the Shoshone, Bighorn, Greybull, Wind, and Popo Agie River drainage basins - a total of 11,800 sq mi. Area 51 contains more than 18 million tons of strippable bituminous coal and extensive deposits of subbituminous coal, in the arid and semiarid basins. The report represents a summary of results of water resources investigations of the U.S. Geological Survey, some of which were conducted in cooperation with State and other Federal agencies. More than 30 individual topics are discussed in brief texts that are accompanied by maps, graphs, photographs, and illustrations. Primary topics in the reports are physiography, resources and economy, surface-water quantity and quality, and groundwater. (USGS)
W89-04067

HYDROLOGY OF AREA 52, ROCKY MOUNTAIN COAL PROVINCE, WYOMING, COLORADO, IDAHO, AND UTAH,
Geological Survey, Cheyenne, WY. Water Resources Div.
H. W. Lowham.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-761, 1985. 96p, 51 fig, 6 tab, 103 ref.

Descriptors: *Coal mining, *Hydrologic data, *Watersheds, *Environmental effects, *Coal hydrology, *Green River, *Wyoming, *Bear River, *Fort Union Formation, Streamflow, Floods, Water quality, Dissolved solids, Suspended sediments, Aquifers, Groundwater, Aquatic environment, Wasatch Formation, Energy development.

This report is one of a series designed to characterize the hydrology of drainage basins within coal provinces, nationwide. Area 52 (in the Rocky Mountain Coal Province) includes the Green River Basin upstream from the Yampa River, and the Bear River upstream from the Bear Lake - a total of 23,870 sq mi. Area 52 contains over 3 billion tons of strippable coal, most of which is located in the arid and semiarid plains. The report represents a summary of results of the water resources investigations of the U.S. Geological Survey, carried out in cooperation with State and other Federal agencies. More than 40 individual topics are discussed in a brief text that is accompanied by maps, graphs, photographs, and other illustrations. Primary topics in the report are: general features, resources and economy, surface-water quantity and quality, and groundwater. (USGS)
W89-04068

HYDROLOGY OF AREA 47, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NORTH DAKOTA, SOUTH DAKOTA, AND MONTANA,
Geological Survey, Bismarck, ND. Water Resources Div.
O. A. Crosby, and R. L. Klausing.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Open-File Report 83-221, 1984. 93p, 38 fig, 7 tab, 29 ref.

Descriptors: *Hydrology, *Groundwater, *Surface water, *Energy, *Drainage, *North Dakota, Water quality, Coal mining, Aquifers, Williston Basin, Fort Union coal region.

This report is one of a series that describes the hydrology of coal provinces nationwide. The Northern Great Plains and Rocky Mountain Coal Provinces are divided into 20 separate reporting areas (43-62). This report provides general hydrologic information for Area 47 using a brief text with accompanying maps, charts, or graphs. This information may be used to describe the hydrology of the general area of any existing or proposed mine. Some of the more obvious hydrologic problems of coal development that will need to be addressed before development are destruction of aquifers and potential contamination of streams, aquifers, and the atmosphere. Area 47 generally is composed of hydrologic units (drainage basins or parts of basins) based on surface-water hydrology. It is drained by the Missouri River and several of its major tributaries. Most of the study area is in North Dakota. Lignite-bearing rocks of late Paleocene age underlie about 95% of Area 47. The minable lignite deposits, which underlie about 70% of the area, occur in the Sentinel Butte and Tongue River Members of the Fort Union Formation. Glacial drift of late Pleistocene age overlies the lignite-bearing rocks in the northern part of the study area. The climate of the area is semiarid. Mean annual precipitation is between 14 and 18 inches. Temperature are less than 0 F an average of 45 days/yr and greater than 90 F or more an average of 14 days/yr. Lake evaporation ranges from 34 to 38 in/yr. A fairly comprehensive data base for streamflow and water quality in streams is available for Area 47. Many of the small stream-monitoring sites have been operated during the last few yrs to provide a data base before coal development. Both the quantity and quality of water varies greatly in all streams, except the Missouri River. A groundwater observation network for water levels and water quality has been established through county groundwater resources studies and other groundwater studies and provides an adequate data base. (USGS)
W89-04069

HYDROLOGY OF AREA 28, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04079

HYDROLOGY OF AREA 46, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES; NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
M. G. Croft, and O. A. Crosby.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-467, 1987. 80p, 36 fig, 9 tab, 44 ref.

Descriptors: *Geohydrology, *Coal mining effects, *Mines, *Groundwater, *Surface water, *North Dakota, Energy, Drainage, Water quality, Coal mining, Aquifers, Environmental impact, Environmental effects, Data collections, Hydrologic data, Williston Basin, Fort Union coal region, Hydrology.

The report provides general hydrologic information for Area 46 of the Northern Great Plains Coal Province using a brief text with accompanying maps, charts, or graphs. The information may be used to describe the hydrology of the general area of any existing or proposed mine. Some of the more obvious hydrologic problems of coal development that will need to be addressed before development are disruption of aquifers, and the potential contamination of streams, aquifers, and the atmosphere. Area 46 is composed of parts or all of 14 hydrologic units delineated by surface drainage basins. The major drainage systems in the area are the Missouri and Souris Rivers. Lignite-bearing rocks of late Paleocene age underlie nearly all of Area 46. The minable lignite deposits occur in the Sentinel Butte and Tongue River Members of the Fort Union Formation. Glacial drift of late Pleistocene age overlies the lignite-bearing rocks. A fairly comprehensive data base is available for streamflow and water quality in streams for Area 46. Many of the small stream sites were operated during recent years to provide a data base before coal development. There is a great areal and time variability in both quantity and quality of water for all streams except the Missouri River. A groundwater observation network for water levels and water quality has been established through county groundwater resource investigations. (USGS)
W89-04112

OVERVIEW OF SURFACE WATER QUALITY IN OHIO'S COAL REGION,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04113

GEOLOGIC, HYDROLOGIC, AND CULTURAL FACTORS IN THE SELECTION OF SITES FOR THE LAND DISPOSAL OF WASTES IN WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-04115

ASSESSMENT OF LOW-FLOW WATER QUALITY IN RICHLAND CREEK, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04117

RAINFALL-RUNOFF DATA FOR SOMERSET COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
J. B. Campbell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-384, 1987. 161p, 1 tab, 11 fig, 12 ref.

Descriptors: *Urbanization, *Stream discharge, *Storm runoff, *Rainfall-runoff relationships, *New Jersey, Rainfall rate, Flood peak, Somerset County, Urban runoff, Rainfall.

Rainfall-runoff data are presented for eight selected drainage basins in Somerset County, New Jersey, for the 1980 through 1984 water yr. In order to improve the existing methods for estimating flood-frequency and magnitude throughout the county, in their flood-monitoring efforts by providing real-time data, rainfall-runoff data were collected and a data base was created. The rainfall-runoff data were recorded at 5-min intervals and were stored in the U.S. Geological Survey, New Jersey District computer. Rainfall data were collected at two sites within each drainage basin in order to improve areal coverage and data continuity. Data from eight rainfall-runoff gaging stations and eight auxiliary rainfall gages are summarized. Rainfall and runoff data for selected storms also are summarized. (USGS)
W89-04130

HYDROLOGIC DATA FOR SELECTED STREAMS IN THE COAL AREA OF SOUTHEASTERN OKLAHOMA, JULY 1978 TO SEPTEMBER 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
S. P. Blumer, and L. A. Alf.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-319, 1987. 337p, 5 fig, 9 tab, 8 ref.

Descriptors: *Oklahoma, *Coal mining impacts, *Environmental impact, *Water pollution sources, *Geohydrology, Surface waters, Groundwater, Water quality.

Hydrologic data on quantity and quality of surface waters were collected in the coal resource area of southeastern Oklahoma during an investigation of the effects of coal surface mining on the hydrology of the area. The objective of the study was to determine the characteristics of the regional hydrologic system and to detect and document changes in the system that may occur as the result of coal surface mining. This report presents data which were collected at 13 sites in 4 counties between July 1978 and September 1982. The data include: (1) mean daily stream discharge; (2) physical properties, selected field constituents, and concentration of suspended sediment of water samples; (3) concentration of selected common constituents, nutrients, and trace elements of water samples; (4) mean daily specific conductance, pH, water temperature, and dissolved oxygen; and (5) analyses of biological samples. (USGS)
W89-04158

PROPOSED WORK PLAN FOR THE STUDY OF HYDROLOGIC IMPACTS OF GROUNDWATER DEVELOPMENT IN THE WET MOUNTAIN VALLEY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
S. G. Robson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-866, 1985. 13p, 5 ref.

Descriptors: *Groundwater, *Geohydrology, *Water budget, *Colorado, Aquifers, Wet Mountain Valley, Huerfano Formation, Santa Fe Formation.

Large-scale development of groundwater resources in the Wet Mountain Valley, Colorado, could adversely affect other water rights in the valley or in the Arkansas River Basin. Such infringement on senior water rights could severely limit development of additional water supplies in the valley. A work plan is presented for a study that is intended to define the hydrologic system in the valley better, and to determine the extent that the quantity and chemical quality of both surface and groundwater in the valley might be affected by proposed development. (USGS)
W89-04162

HYDROLOGY OF AREA 50, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, WYOMING AND MONTANA,
Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Lowry, and J. F. Wilson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-545, 1986. 137p, 93 fig, 15 tab, 370 ref.

Descriptors: *Coal mining, *Hydrologic data, *Environmental effects, *Coal hydrology, *Wyoming, *Montana, Streamflow, Floods, Water quality, Dissolved solids, Suspended sediments, Geomorphology, Aquifers, Groundwater, Aquatic environment, Uranium, Powder River, Belle Fourche River, Fork Union Formation, Campbell County, Wasatch formation, Cheyenne River, Wyodak coalbed.

This report is one of a series designed to characterize the hydrology of drainage basins within coal provinces, nationwide. Area 50 includes all of the Powder River Basin, Wyoming and Montana and the upstream parts of the Cheyenne and Belle Fourche River Basins - a total of 20,676 sq mi. The area has abundant coal (81.2 million tons mined in 1982), but scarce water. The information in the report is intended to describe the hydrology of the 'general area' of any proposed mine. The report represents a summary of results of the water resources investigations of the U.S. Geological Survey, carried out in cooperation with State and other Federal agencies. Each of more than 50 topics is discussed in a brief text that is accompanied by maps, graphs, and other illustrations. Primary topics in the report are: physiography, economic development, surface-water data networks, surface water quantity and quality, and groundwater. The report also contains an extensive description of sources of additional information. (USGS)
W89-04163

EFFECT OF SHELTERBELTS ON GROUNDWATER FORMATION,
All-Union Research Inst. of Agricultural Forest Reclamation, Volgograd (USSR).
For primary bibliographic entry see Field 2F.
W89-04281

RECENT HUMAN INFLUENCES ON THE ECOLOGY OF LOCH LOMOND, SCOTLAND,
Paisley Coll. of Tech. (Scotland). Dept. of Biology.
J. D. Hamilton.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 403-413, January 1988. 3 fig, 9 tab, 19 ref.

Descriptors: *Acid rain effects, *Loch Lomond, *Ecological effects, *Lakes, *Water quality management, *Water pollution effects, Parks, Recreation facilities, Recreation, Wastewater, Fish, Acidity, Roads, Transportation, Planning, Ecology, Monitoring, Water supply, Reviews.

The ecological changes that have taken place in the last 15 years in Loch Lomond, Scotland are reviewed, and the possible effects of new developments around the loch shores are considered. Many of the long-standing, and some of the more recent, influences appear to be having only minor effects on the ecology of the loch. This may be a consequence of the loch's size, morphometry, and variety of features, although constant surveillance is necessary to warn of future damage. Threats to the loch include recreational abuse, pollution, eutrophication, land use change, mineral workings, electricity generation, water abstraction, and water level control. Special attention should be given to acidification (especially the northern inflows), dumping of road works spoil, construction of the Glen Fruin road, further development of the water supply scheme, implementation of the Loch Lomond Park Plan, future implementation of pumped storage hydroelectricity scheme, and introduction of new species. (Author's abstract)
W89-04520

4D. Watershed Protection

ASSESSMENT OF THE ROLE OF BOTTOMLAND HARDWOODS IN SEDIMENT AND EROSION CONTROL.
Fish and Wildlife Service, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-190640. Price codes: A06 in paper copy, A01 in microfiche. Report No. NERC-88/11, February 1988. 116p, 3 append. Edited by Albert Molinas, Gregor T. Auble, Charles A. Segelquist and Lee S. Ischinger.

Descriptors: *Bottomland, *Forest hydrology, *Erosion control, *Sedimentation, *Hardwood, Vegetation, Erosion, Flow velocity, Soil stability, Litter, Overland flow, Geohydrology, Land use.

Drainage and clearing of bottomland hardwoods have long been recognized by the EPA and the Fish and Wildlife Service (Service) as important impacts of Federal water projects in the lower Mississippi River Valley. More recently, the water quality impacts of such projects (e.g., increases in sediment, nutrients, and pesticides) have also become of concern. In 1984, in an effort to better define problems concerning wetland losses and water degradation, EPA initiated a cooperative project with the Western Energy and Land Use Team (now the National Ecology Research Center) of the Service. Three phases of the project were identified: (1) to collect existing literature and data; (2) to select, develop, and test the utility of methods to quantify the relationships between land use, cover types, soils, hydrology, and water quality (as represented by sediment); and (3) to apply selected methodologies to several sites within the Yazoo Basin of Mississippi to determine the potential effectiveness of various management alternatives to reduce sediment yield, increase sediment deposition, and improve water quality. Bottomland hardwoods, as considered here, are a wet, forested cover type in the floodplain. They have well-developed canopy and litter layer structures that absorb the kinetic energy of precipitation (i.e., less energy available to detach sediment). Their root structure and litter layer stabilize the erosive soil (i.e., more energy is required to detach sediment). These surface characteristics lead to high surface roughness coefficients that produce low velocities and low transport capacities. Therefore, the sediment contribution to streams from bottomland hardwood areas is much less than from agricultural cover types. (See W89-03352 thru W89-03354) (Lantz-PTT)
W89-03351

MAINSTEM AND OVERBANK FLOW SEDIMENT MOVEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-03352

DESCRIPTION OF LANDSCAPE SEDIMENT MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-03353

EXTENSION'S ROLE IN SOIL AND WATER CONSERVATION,
North Carolina State Univ. at Raleigh.
D. Hoag, S. Lilley, M. Smolen, M. Cook, and J. Wright.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 2, p 126-129, March-April 1988. 11 ref.

Descriptors: *Soil conservation, *Water conservation, Water quality management, *Interagency cooperation, Education, Training, Water use efficiency, Irrigation efficiency, Natural resources, Economic aspects, Social aspects.

Managers of soil and water conservation programs must typically take into account many variables simultaneously, such as government intervention, pollution wildlife management, forestry, and agronomic and social factors. The dynamic nature of soil and water conservation makes it difficult for the Cooperative Extension Service and other agriculturally based agencies to respond with appropriate actions. The Extension Service has recently increased its emphasis on the off-site problems related to agricultural productivity. Growing interest in the off-site impacts of agricultural production has thrust Extension into an area of education involving new approaches, audiences, and training. Extension operates using a bi-directional information flow between Extension users, county agents, on-campus specialists, and research providers; this establishes a mechanism whereby the shared experience of research consumers helps to guide the agenda of research providers at land-grant universities. Cooperative Extension is committed to continue its support of educational programs related to soil and water conservation. Relatively few Extension programs address goals related exclusively to soil and water use. Through 1985, the primary soil-related or water-related goals were soil conservation, followed directly by water quality and distantly by water conservation. In Extension's current planning cycle, water quality concerns are moving ahead of soil conservation goals. Extension's strength derives from its association with research and its ability to educate farmers and other sectors of the public about the use and benefits of new technologies. Respondents to a 1985 Extension survey felt that Extension should offer leadership in soliciting interagency cooperation in reducing pollution through the public sector rather than through agricultural practices. The economics of studying the off-farm impacts of soil and water management are discussed along with the future emphasis of Extension research. (Geiger-PTT)
W89-03892

CRITICAL SCOUR: NEW BED PROTECTION DESIGN METHOD,
Delft Geotechnics (Netherlands).
For primary bibliographic entry see Field 8B.
W89-03979

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

QUALITY CONTROL EXPERIMENTS ON ORGANICS IN GROUND WATER AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY, LIVERMORE, CALIFORNIA,
Lawrence Livermore National Lab., CA.
W. A. McConachie, D. N. Homan, and D. W. Rice.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-005226. Price codes: A02 in paper copy, A01 in microfiche. Report No. UCRL--97737, January 1988. 4p, 5 fig, 1 tab, 3 ref. DOE Contract W-7405-Eng-048.

Descriptors: *Water analysis, *Quality control, *Monitoring, *Organic compounds, *California, *Groundwater pollution, *Path of pollutants, Lawrence Livermore National Laboratory, Volatile organic compounds, Groundwater pollution, Monitoring, Trichlorethylene, Solvents, Tetrachloroethylene, Dichloroethene, Trichloroethane, Chloroform, Carbon tetrachloride.

The Lawrence Livermore National Laboratory (LLNL) site was used a as U.S. Naval Air Station for pilot training and aircraft engine re-work from 1942 to 1946. The site and adjacent land are underlain by complexly interbedded alluvial sediments. Hydraulic conductivities vary over three orders of magnitude. The hydraulic gradient is generally westward. The groundwater sampling network includes 200 wells completed in various water bearing zones beneath LLNL and adjacent land. Monitor wells are sampled quarterly, semianually, or annually, depending on the well's position in the VOC (volatile organic compound) plume. Two commercial California-certified laboratories analyze the samples for purgeable halocarbons and purgeable priority pollutants by EPA Methods 601 (8010) and 624 (8240), respectively. Up to 1300 ppb tetrachloroethylene (PCE) and 5700 ppb trichloroethylene (TCE) have been reported in the groundwater from locations on the LLNL site where the US Navy had used these VOCs as solvents. Downgradient from the LLNL site, groundwater contains up to 490 ppb PCE, and up to 120 ppb 1,1,-dichloroethane (1,1,-DCA) and lower concentrations of 1,1,-dichloroethylene (1,1-DCE), 1,2-DCE, 1,1,1-trichloroethane (1,1,1-TCA), chloroform, and carbon tetrachloride. The California Department of Health Services drinking water actions levels for PCE and TCE are 4 and 5 ppb, respectively. The nearest, private drinking water well is about 0.5 km from the forward edge of the VOC plume, but not in its direct migration path; the nearest municipal well is 2.4 km from the forward edge. The EPA has recommended preanalysis storage time is conservative and headspace from effervescing samples has a minor effect on the sample VOC concentrations. A transient bias was observed between the two analytical labs, in spite of their use of nearly identical instrumentation and reference materials. In some wells the VOC concentrations and groundwater surface elevation covary. (Lantz-PTT)
W89-03358

INORGANIC AND ORGANIC MICRO POLLUTANTS IN INDUSTRIAL WASTE WATER (ANORGANISCHE EN ORGANISCHE MICROVERONTREINGINGEN IN INDUSTRIEEL AFVALWATER),
Ministerie van Verkeer en Waterstaat, The Hague (Netherlands). Afdeling Emmissie-Onderzoek.
For primary bibliographic entry see Field 5B.
W89-03363

CHEMISTRY OF ATMOSPHERIC PRECIPITATION AT LEWES, DELAWARE AS PART OF THE MAP3S STUDY: ANNUAL TECHNICAL PROGRESS REPORT, AMENDMENT A002.
Delaware Univ., Lewes. Coll. of Marine Studies.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-002514. Price codes: A02 in paper copy, A01 in microfiche. Report No. DOE/ER/60293--2, (1987). 6p. DOE Grant DE-FG02-85ER60293.

Descriptors: *Acid rain, *Air pollution, *Chemical analysis, *Lewes, Delaware, MAP3S, Hydrogen ion concentration, Acidity, Sulfates, Nitrates, Aerosols.

Qualitatively, results to date are consistent with other inland MAP3S sites, with an observed summer maximum in acidity reflecting seasonal peaks in the two major acid components. Quantitatively, the long-term volume-weighted proton concentration is 46.1 microequiv/L, which corresponds to a pH of 4.34. For the same period, the concentration of excess (non-marine) SO4(2-) and NO3(-) are 42.1 and 20.2 microequiv/L, respectively. In examining the long-term data record, there do not appear to be any systematic trends for precipitation acidity or either acid anion. the incorporation of marine aerosols in local precipitation. Investigations on the incorporation of marine aerosols in local precipitation have revealed that seasalt derived SO4(2-) comprises only an average of about 14% of the total sulfate. However, for storms of oceanic origin, or during winter months characterized by higher winds and lower total sulfate levels, this percentage can be significantly higher. Within the past year, the entire MAP3S major ion data base by event went onto a computer file, and merging this file with trace element data. This computerization has provided a more practical way to store, edit, and retrieve in excess of 600 events collected at the Lewes MAP3S site. The resulting chemical and meteorological data file provides more rapid and sophisticated statistical and graphics capabilities through the use of appropriate software. (Lantz-PTT)
W89-03385

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 1.
Engineering-Science, Inc., Denver, CO.
For primary bibliographic entry see Field 5B.
W89-03388

DETERMINATION OF NATURAL RADIONUCLIDES IN A COASTAL MARINE SEDIMENT: AN ANALYSTS' INTERCOMPARISON EXERCISE,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Research.
B. R. Harvey, and A. K. Young.
Science of the Total Environment STENDL, Vol. 69, p 13-28, 1988. 4 tab, 7 ref, append.

Descriptors: *Pollutant identification, *Marine sediments, *Radioisotopes, *Coastal waters, Baseline studies, Chemical analysis, Comparison studies, Uranium radioisotopes, Radium radioisotopes, Lead radioisotopes, Homogeneity, Contamination, Reproducibility.

An intercomparison undertaken by a group of analysts from six United Kingdom laboratories is described in this paper. The study involved the determination of uranium 238, 235, and 234, radium 226, and lead 210. The starting material was a fine-grained surface sediment taken from the Irish Sea bed west of the Isle of Man. After homogenizing by rolling in a barrel for 24 hours, 1-g subsamples were tested for homogeneity by delayed-neutron analysis of the natural uranium content. Some participants included steps in their separation procedures specifically to remove transuranic nuclides. Contamination of Irish Sea sediments, with neptunium 237 for example, represents a potential interference in the alpha spectrometric measurement of U 234, but the U-234 to U-238 ratios gave no indication of such contamination in any of the results reported. All participants undertaking the analysis for Pb 210 did so by measuring the Polonium 210 granddaughter and assuming equilibrium. Only two laboratories reported data for Ra 226 and results were inconclusive. A subsidiary objective was to assess the limitations of the acid-leaching technique for the determination of natural-series radionuclides in coastal marine sediments. Simple acid leaching gave uranium concentrations less than 50% of those obtained by total-dissolution methods. The spread of the results suggests that at least some of the analytical procedures used need further investigation. (Shidler-PTT)
W89-03397

INTERLABORATORY STUDY OF MERCURY IN FISH BASED ON THE ONTARIO FISH CONTAMINANT MONITORING PROGRAM,
Ontario Ministry of the Environment, Thunder Bay (Ontario).
P. Leung, and D. E. Coceancic.
Science of the Total Environment STENDL, Vol. 71, No. 1, p 131-139, April 1988. 6 fig, 3 tab, 4 ref.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Descriptors: *Pollutant identification, *Mercury, *Fish, *Laboratories, *Ontario, Monitoring, Quality control, Animal tissues, Calibrations, Reproducibility.

Sport fish in Ontario are routinely analyzed by two Laboratories of the Ontario Ministry of the Environment in support of the Fish Contaminant Monitoring Programme. As part of the quality-assurance process to maintain data compatibility, the mercury levels of about 750 fish samples from Northern Ontario were determined in an extensive interlaboratory study. Rather than the usual subsampling from homogenized samples, the two fillets from each fish were split and sent to each laboratory. Short-term calibration bias caused poor data agreement in highly-contaminated fish from Clay Lake. Otherwise, mercury results in these samples showed good agreement between the two laboratories on a long-term basis. (Author's abstract)
W89-03404

NEW METHOD FOR EXTRACTION OF C.I. REACTIVE RED 4 AND ITS DERIVATIVES FROM WATER,
Bayreuth Univ. (Germany, F.R.).
K. W. Schramm, M. Hirsch, R. Twele, and O. Hutziner.
Water Research WATRAG, Vol. 22, No. 8, p 1043-1045, August 1988. 2 fig, 4 tab, 6 ref. Umweltbundesamt, Berlin grant 10605032.

Descriptors: *Dyes, *Pollutant identification, *Separation techniques, Organic carbon, Water analysis, High performance liquid chromatography, Wastewater analysis, Nutrients, Dye concentrations, Fate of pollutants.

During environmental-fate studies in outdoor ponds where the polar dye stuff Reactive Red 4 was used as a representative for this class of dyestuff, the problem of analysis had to be solved for environmental-concentration (ppm) range. A rapid method for analysis of Reactive Red 4 from aqueous solutions by extraction with cyclohexanol and subsequent high performance liquid chromatography (HPLC) separation was developed. This method is applicable for concentrations as low as 1 ppb and can be used for C.I. Reactive Red 4, its hydroxy and methoxy derivatives and two other related colored derivatives. The methoxy derivative is useful as an internal standard during the extraction of water with high organic carbon content. (Geiger-PTT)
W89-03442

IDENTIFICATION OF GROUP A COXSACKIEVIRUSES FROM SEWAGE SAMPLES BY INDIRECT ENZYME LINKED IMMUNOSORBENT ASSAY,
Defence Research and Development Establishment, Gwalior (India). Div. of Microbiology.
G. Pandya, A. M. Jana, U. Tuteja, and K. M. Rao.
Water Research WATRAG, Vol. 22, No. 8, p 1055-1057, August 1988. 2 tab, 16 ref.

Descriptors: *Enzymes, *Coxsackie virus, *Pollutant identification, *Wastewater, Assay, Mice.

Group A coxsackieviruses (propagable in infant mice) were recovered from sewage samples, in mouse torso and identified by an indirect enzyme linked immunosorbent assay (ELISA). One hundred and thirteen sewage samples were collected from 25 different sampling sites of urban areas in Gwalior over a year. Thirty four strains of 13 types of group A coxsackieviruses were identified from 20 isolates obtained from 20 positive sewage samples showing characteristic coxsackievirus A infections in mice. The suitability of an indirect ELISA technique, standardized by the authors for the identification of group A coxsackieviruses existing in sewage, is discussed. (Author's abstract)
W89-03444

GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC CONFIRMATION OF IDENTITY OF COPROSTANOL IN MERCENARIA MERCENARIA (BIVALVIA) TAKEN FROM SEWAGE-POLLUTED WATER,
Food and Drug Administration, Washington, DC. Center for Food Safety and Applied Nutrition.
J. E. Matusik, G. P. Hoskin, and J. A. Sphon.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 71, No. 5, p 994-999, September-October 1988. 6 fig, 2 tab, 14 ref.

Descriptors: *Clams, *Indicators, *Coprosterol, *Pollutant identification, Organic compounds, Gas chromatography, Separation techniques, Mass spectrometry.

Coprostanol is a major fecal sterol in humans and may, therefore, be a good indicator of sewage-polluted waters. Some types of edible seafood, such as clams, that live in these waters may be contaminated with coprostanol. Coprostanol from clam tissue extracts had been previously quantitated by gas chromatography (GC). In the present work, capillary column GC was used to separate coprostanol, and electron ionization mass spectrometry was used to confirm its identity. Confirmation of identity of coprostanol at the 75 ng level was obtained by comparing the spectrum of the authentic standard with spectra of the clam tissue extract obtained under the same instrumental conditions. Various other compounds can be eliminated as potential interferences by virtue of either their different GC retention times or their spectra. (Author's abstract)
W89-03471

RESIDUE LEVEL DETERMINATION OF THE AQUATIC HERBICIDE FLURIDONE AND A POTENTIAL PHOTOPRODUCT (N-METHYLFORMAMIDE) IN WATER,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
S. D. West, and L. G. Turner.
Journal - Association of the Official Analytical Chemists JANCA2, Vol. 71, No. 5, p 1049-1053, September-October 1988. 3 fig, 3 tab, 7 ref.

Descriptors: *Herbicides, *Pollutant identification, Pesticide residues *Chromatography, Organic compounds.

Methods are presented for the determination of the aquatic herbicide fluridone and N-methylformamide (NMF), a potential photoproduct of fluridone which has thus far been observed only in a laboratory aqueous photolysis study. Water samples are passed through a Sep-Pak C18 cartridge to extract fluridone while NMF passes unretained through the cartridge with the water. Fluridone is eluted from the cartridge with methanol, which is then concentrated for analysis by liquid chromatography with UV detection at 313 nm. The water eluate containing NMF is concentrated for analysis by rotary vacuum evaporation at 40-46 C. Methanol is added to help evaporate the water, and glycerol is added as a keeper solvent to retain NMF during the evaporation. The residual NMF is dissolved in methanol for analysis by gas chromatography with a Hall electrolytic conductivity detector operated in the nitrogen mode. The assay limits of detection are 1 and 2 ppb for fluridone and NMF, respectively. Recoveries averaged 98% for fluridone at 1-400 ppb and 87% for NMF at 2-50 ppb. (Author's abstract)
W89-03472

DETECTION OF PENTACHLOROPHENOL AND ITS GLUCURONIDE AND SULFATE CONJUGATES IN FISH BILE AND EXPOSURE WATER,
Washington State Univ., Pullman. Coll. of Pharmacy.
G. R. Stehly, and W. L. Hayton.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 23, No. 4, p 355-366, August 1988. 1 fig, 2 tab, 15 ref. NIH Grant ES 01995, EPA Grant R812818.

Descriptors: *Pollutant identification, *Goldfish, *Pentachlorophenol, Chlorinated hydrocarbons, High pressure liquid chromatography, Separation techniques, Pesticides.

The glucuronide and sulfate conjugates of pentachlorophenol (PCP) that were present in the bile and exposure water of goldfish (Carassius auratus) were used to develop methodology to quantify PCP and its metabolites. Reverse phase HPLC with radioactivity detection separated PCP and its metabolites, and was used to verify a method of quantification that used differential extraction and scintillation counting. Extractions of aqueous phase at pH 2 or 8, with butanol, ethyl acetate, or ether indicated that ether at pH 8 best separated PCP from its metabolites. The sulfate conjugate of PCP was the major metabolite produced when goldfish were exposed to 125 micrograms of C14-PCP/l. It was present primarily in the exposure water, but also appeared in the bile. (Author's abstract)
W89-03485

HYDROCARBONS AND PHENOLS IN DISCHARGE WATER FROM OFFSHORE OPERATIONS: FATE OF THE HYDROCARBONS IN THE RECIPIENT,
Bergen Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-03512

CYTOCHROMES P-450 IN FISH LARVAE: IMMUNOCHEMICAL DETECTION OF RESPONSES TO OIL POLLUTION,
Bergen Univ. (Norway). Dept. of Biochemistry.
For primary bibliographic entry see Field 5C.
W89-03516

HEAVY METALS IN MARINE NEMERTEANS,
Liverpool Polytechnic (England). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-03539

EFFECT OF AGRICULTURE ON THE PRIMARY PRODUCTION IN LAKE BESKIE (POLAND) AS RECORDED IN THE STRATIGRAPHY OF FOSSIL PIGMENTS,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
For primary bibliographic entry see Field 5C.
W89-03540

COMPARISON OF PERIPHYTON COMMUNITY STRUCTURAL AND FUNCTIONAL RESPONSES TO HEAVY METALS,
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
M. J. Crossey, and T. W. La Point.
Hydrobiologia HYDRB8, Vol. 162, No. 2, p 109-121, May 16, 1988. 5 fig, 3 tab, 29 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Heavy metals, *Stream biota, *Plant populations, *Epiphytes, Productivity, Respiration, Dry matter, Chlorophyll a, Mineral industry, Mine wastes, Montana, Statistical analysis.

This study evaluates the effectiveness of community-production and respiration measurements as monitoring tools for environmental-impact evaluations and compares these data to community structural data. Spring Creek, which joins Prickly Pear Creek at Jefferson City, Montana, is contaminated with high concentrations of cadmium, copper, lead, silver, and zinc, which are being leached from waste piles associated with mining, milling, and smelting operations of the late 1800s. In Prickly Pear Creek production and respiration rates were determined for periphyton communities in control, impact, and recovery reaches using colonized granite substrates and sealed plexiglas chambers. Values for gross primary productivity (GPP), community respiration (CR), ash-free dry mass (AFDM) and chlorophyll a content (Chla) were obtained for each granite slab. Of these, AFDM, Chla, and CR were statistically significant among sites ($P < \text{or} = 0.01$). Although mean values for GPP appeared to differ among reaches, statistical differences could not be inferred because of large variances associated with this measure. These data indicate that inherent variability may limit the use of community-function measures in routine envi-

ronmental monitoring. However, production/respiration methods provide valuable data about emergent properties of aquatic communities that cannot be derived from routine population censuses. (Author's abstract)
W89-03579

PREPRINTS OF PAPERS PRESENTED AT THE 196TH ACS NATIONAL MEETING.
For primary bibliographic entry see Field 5B.
W89-03595

SELECTION OF TREND ANALYSIS TECHNIQUES FOR WATER QUALITY DATA,
Office of the Assistant Secretary for Water and Science, Washington, DC.
R. M. Hirsch.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 16-19. 8 ref.

Descriptors: *Trend analysis, *Statistics, *Data interpretation, *Chemical analysis, *Water analysis, *Pollutant identification, *Statistical analysis, Water pollution, Water quality, Seasonal variation, Monitoring.

Some of the key issues involved in selecting a protocol for trend analysis and, in particular, techniques which are useful for large studies involving data for multiple monitoring stations and/or multiple chemical constituents are discussed. The analysis of routine monitoring data should include the use of robust techniques for detecting monotonic trends in water quality over time and for estimating the slope or magnitude of the trends. A data-analysis protocol for routine monitoring programs should be selected on the basis of prior knowledge of the characteristics the data set is expected to have, and not on an evaluation of the data in hand, for analysis. The technique should not depend on the data conforming to any specific probability distribution. It is very unlikely that all data-sets analyzed will conform to one particular distribution. Thus, the use of distribution-specific procedures will result in non-comparable results being developed for the various data sets. The technique should work well in the presence of seasonal variation. In long-term trend analysis, seasonal variation can be viewed as a type of noise which should be removed from the data. However, many data sets are too small to allow for development of a reliable model of this source of variation. Removal of seasonal variation without explicit modeling of seasonality may be preferred. The technique should work well in the presence of censored data. Data sets for toxic compounds or trace elements often contain many observations reported as below the limit of detection. There are two types of approaches to dealing with such data: (1) the use of nonparametric or rank-based tests, and (2) the use of likelihood theory methods which involve the use of distributional assumptions. (See also W89-03595) (Miller-PTT)
W89-03599

PARTIAL RANK CORRELATION TEST IN WATER QUALITY DATA ANALYSIS,
University of Western Ontario, London. Dept. of Statistical and Actuarial Sciences.
For primary bibliographic entry see Field 7C.
W89-03601

ANALYTICAL PROCEDURES FOR THE DETERMINATION OF DISPERSE AZO DYES,
Environmental Protection Agency, Las Vegas, NV.
L. D. Betowski, T. L. Jones, W. Munslow, and N. J. Nunn.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 184-185. EPA contract 68-03-3249.

Descriptors: *Chemical analysis, *Dyes, *Wastewater treatment, *Activated sludge process, *Anaerobic digestion, Disperse Blue 79 dye, Disperse Red 1 dye, Wastewater analysis, Spectrometry, Monitoring, Dye industry wastes, Degradation products.

The development of methods for the analytical determination of Disperse Blue 79 and any possible degradation products in wastewater involved various phases. The first step was the purification of commercial material or presscake to obtain a standard for quantitative determination. Phase two involved the extraction of the dye from the matrices. Distilled water was used as the first spiking media and then raw effluent wastewater, waste activated sludge and anaerobic digestor effluent were spiked with Disperse Blue 79 and subjected to extraction methods. The third phase was the actual testing of the Disperse Blue 79 in the waste activated sludge system and anaerobic digestor. Recovery of the dye and any degradation products at each sampling point was the goal of this phase. Several potential degradation products were monitored, including bromodinitroaniline which could result from reduction followed by cleavage of the azo bond and bromonitrodiaminobenzene. A project to monitor the fate of Disperse Red 1 revealed degradation products associated with both reduction of a nitro group and the azo linkage. Tandem mass spectrometric methods were used in conjunction with thermospray ionization to obtain additional structural information on possible degradation products. (See also W89-03595) (Miller-PTT)
W89-03615

SOLUBILITY OF DISPERSE DYES -- ENVIRONMENTAL IMPLICATIONS,
Environmental Research Lab., Athens, GA.
G. L. Baughman, and T. A. Perenich.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 195-196. 1 tab, 5 ref.

Descriptors: *Water analysis, *Pollutant identification, *Dyes, *Dye dispersion, *Solubility, *Path of pollutants, Estimating, Partitioning, Dimerization.

Experimental results are presented for the water solubility of several newer disperse dyes of known structure measured by a generator column method. The solubilities span a range of from 7 times 10 to the minus 7th power to 3 times 10 to the minus 10th power M corresponding to the log Kow (octanol-water partition coefficient) range of 3.4 to 6. The data confirm previous predictions that many of the older disperse dyes that have published structures do indeed have a significant potential to accumulate. They also confirm that some widely used computational methods for estimation of water solubility and Kow are often high or low, respectively, by as much as one to two orders of magnitude. Implications of the results are discussed with regard to partitioning, to the use of thin layer chromatography and high performance liquid chromatography to estimate solubility or Kow, and to the possible role of dimerization. (See also W89-03595) (Author's abstract)
W89-03619

REDUCTION OF TOXIC WASTEWATERS IN DISPERSE AZO DYE MANUFACTURE,
CIBA-GEIGY Corp., Toms River, NJ.
For primary bibliographic entry see Field 5D.
W89-03620

LIVER STRUCTURAL ALTERATIONS ACCOMPANYING CHRONIC TOXICITY IN FISHES: POTENTIAL BIOMARKERS OF EXPOSURE.
California Univ., Davis. School of Medicine.
For primary bibliographic entry see Field 5C.
W89-03621

HISTOPATHOLOGY OF ATLANTIC TOMCOD: A POSSIBLE MONITOR OF XENOBIOTICS IN NORTHEAST TIDAL RIVERS AND ESTUARIES,
Louisville Univ., KY.
For primary bibliographic entry see Field 5C.
W89-03622

CROAKER (NIBEA MITSUKURII) AND THE SEA CATFISH (PLOTOSUS ANGUILLARIS) MAY BE CONSIDERED AS USEFUL BIOMARKERS OF COASTAL POLLUTION,
Shizuoka Univ. (Japan). Lab. of Food Hygiene.
For primary bibliographic entry see Field 5C.
W89-03623

MACROPHAGE RESPONSES OF ESTUARINE FISH AS BIOINDICATORS OF TOXIC CONTAMINATION,
Virginia Inst. of Marine Science, Gloucester Point.
B. A. Weeks, R. J. Huggett, J. E. Warinner, and E. S. Mathews.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 245-247.

Descriptors: *Bioindicators, *Toxicity, Estuarine environment, *Fish physiology, *Toxic wastes, *Hydrocarbons, *Water pollution effects, Macrophage, Tributylin, Rivers.

Chemical pollutants have been shown to affect (depress or stimulate) functional elements of the immune system of fish. Therefore, measurement of the immune response can provide information about exposure to environmental stress. It has been shown that fish exposed to toxic pollutants both in the wild and in the laboratory show significant changes in the immune activity of kidney macrophages. Macrophages are an important part of the cellular immune system and function as the first line of defense by degrading foreign material including disease-causing agents. Various aspects of macrophage activity including chemotaxis, phagocytosis, pinocytosis, melanin accumulation, chemiluminescence and random migration have been investigated and found to be affected by exposure to toxic chemicals. Macrophages from fish exposed to toxic contaminants showed responses which were suppressed or elevated depending on the species and activity tested. The macrophage activity of fish exposed to polluted river water returned to normal after the fish were held in clean water for 3 wk. It is proposed that these assays of cellular immune function can serve as bioindicators of aquatic pollutants. (See also W89-03595) (Author's abstract)
W89-03624

IDENTIFICATION AND APPLICATION OF PHYSIO-CHEMICAL MARKERS TO DEMONSTRATE BIOLOGICAL RESPONSE,
Maryland Dept. of Natural Resources, Oxford, MD.
For primary bibliographic entry see Field 5C.
W89-03625

USE OF BIOENERGETIC MEASUREMENTS FOR DETECTING SUBLETHAL POLLUTANT-INDUCED STRESS IN AQUATIC ORGANISMS,
Battelle Ocean Sciences, Duxbury, MA.
R. S. Carr.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 254-256. 12 ref.

Descriptors: *Toxic wastes, *Bioindicators, *Toxicity, *Stress, *Water pollution effects, *Sublethal effects, Oxygen, Nitrogen, Bioenergetic measurements, Zooplankton, Sludge disposal, Municipal wastes.

The relevance of bioenergetic measurements for predicting potential population effects was demonstrated. As part of the EPA monitoring program at the 106-mile Deepwater Municipal Sludge Site, short-term toxicity tests were conducted at sea with indigenous zooplankton as well as standardized test species exposed to water column and sea-surface microlayer samples obtained from sewage sludge discharge plumes. At the termination of

these short-term tests, O:N ratio measurements were made on surviving individuals as an additional measure of sublethal effects. Preliminary results from these field studies are presented and the use of this approach for both laboratory and field investigation is discussed. (See also W89-03595) (Miller-PTT)
W89-03626

INTESTINAL NUTRIENT ABSORPTION - A BIOMARKER FOR DELETERIOUS HEAVY METALS IN AQUATIC ENVIRONMENTS,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Biological Sciences.
A. Farmanfarmaian.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 257-260. 3 tab, 5 ref.

Descriptors: *Toxicity, *Toxic wastes, *Bioindicators, *Heavy metals, *Absorption, *Water pollution effects, *Nutrients, Mercury, Cadmium.

The deleterious effects of heavy metals on absorptive processes at the membrane surface of vertebrates and higher invertebrates is summarized. In polluted waters, deleterious heavy metals such as mercury and cadmium enter the intestinal tract of animals via food or drink. They bind to, or bind and penetrate into the membrane of the absorptive enterocyts facing the lumen of the intestine. This interaction accumulates the heavy metal in the tissue and impairs the normal digestive-absorptive functions of integral and extrinsic proteins associated with the membrane. Extensive in vivo and in vitro measurements of essential amino acid absorption at various heavy metal concentrations in different marine and estuarine species of fish and invertebrates show severe or moderate reductions in amino acid absorption. Both active transport and facilitated diffusion mechanisms may be affected. This malabsorption potentially results in reduced growth, abnormal development and immune insufficiency. The measurement of intestinal absorption of specific nutrients can be used as a biomarker for assessing heavy metals hazards in the environment. (See also W89-03595) (Author's abstract)
W89-03627

METALLOTHIONEIN AS A BIOMARKER OF ENVIRONMENTAL METAL EXPOSURE: SPECIES-DEPENDENT EFFECTS,
Northeast Louisiana Univ., Monroe. Toxicology Program.
W. H. Benson, K. N. Baer, and C. F. Watson.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 272-273. 4 ref.

Descriptors: *Metallothionein, *Toxic wastes, *Bioindicators, *Metals, *Heavy metals, *Fish, *Water pollution effects, Sunfish, Liver, Stress, Zinc, Copper.

Because of the paucity of data concerning the induction of metallothionein (a metal-binding protein induced by heavy metals) following stress in teleosts, the influence of environmental stresses (cold, hypoxia) on metallothionein induction in bluegill sunfish, lepomis macrochirus, was investigated. Following exposure to environmental stressors, significant decreases in zinc and copper were observed in the gill metallothionein-like fraction, as compared to the control. In teleost liver, no significant alterations were observed in the metallothionein-like fraction, compared to the control. These results support the conclusion that the induction of teleost hepatic metallothionein-like proteins appears to more metal-specific. (See also W89-03595) (Author's abstract)
W89-03629

METAL-BINDING PROTEINS FOR THE DETECTION OF HEAVY METALS IN AQUATIC ORGANISMS,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
D. H. Petering, P. Chen, J. Garvey, M. Goodrich, and S. Krezoski.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 275-277. NIEHS grants ESO4184 and ESO1629.

Descriptors: *Toxic wastes, *Bioindicators, *Metallothionein, *Fish, *Metals, *Heavy metals, *Chelating agents, *Water pollution effects, Copper, Zinc, Cadmium, Mercury, Tadpoles, Liver, Proteins, Peptides.

The potential in aquatic organisms for metal-binding proteins and peptides, which are analagous to metallothionein, to serve as biomarkers was investigated. Laboratory research on the presence, nature, and chemical and biological properties of copper, zinc and copper-binding molecules illustrates some of the issues involved in their use as sentinals of environmental heavy metal contamination. Non-mammalian organisms chelate copper, zinc, cadmium, and mercury in diverse proteins/peptides. Freshwater fish normally contain an hepatic zinc, copper-protein/peptide. Immunologically different from metallothionein, it behaves chemically like it. Stress (restraint) redistributes metal and kidney proteins/peptides. In some fish, dietary cadmium accumulates in liver proteins/peptides and cadmium in water accumulates in kidney proteins/peptides. Stress does not affect the hepatic uptake of cadmium from food. Tadpoles concentrate cadmium better than fish, binding it to liver cadmium-proteins/peptides. These results and comparisons with mammalian systems illustrate the use of proteins/peptides as an environmental marker for the presence, bioaccumulation and effects of heavy metals. (See also W89-03595) (Miller-PTT)
W89-03630

INVESTIGATIONS INTO THE POSSIBLE USES OF MARINE FLATFISH METALLATHIONEIN CONCENTRATIONS AS AN INDICATOR OF TOXIC METAL EXPOSURE,
Institute of Marine Biochemistry, Aberdeen (Scotland).
J. Overnell, T. C. Fletcher, and R. McIntosh.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 284-286. 1 fig.

Descriptors: *Metallathionein, *Toxic wastes, *Bioindicators, *Fish, *Toxicity, *Metals, *Seasonal variation, *Water pollution effects, Silver saturation assay, Stress, Flatfish, Zinc, Copper.

Marine flatfish were investigated to see if they are capable of enhanced induction of metallothionein, whether non-metal stress-associated agents induce metallothionein, the nature of the seasonal variation of endogenous metallothionein, and the effect of supplemental dietary zinc and copper on metallothionein concentrations. At final sampling there was no significant difference between control and test animals in hepatic and renal metallothionein levels, hepatic and renal zinc levels and white muscle, skin and bone zinc concentrations. Hepatic and renal copper, zinc, and metallothionein concentration was unchanged, as measured by a silver saturation assay based on the use of radioactive silver. However, liver copper showed significantly higher concentration in the test fish over the control fish. (See also W89-03595) (Miller-PTT)
W89-03631

CHARACTERIZATION OF C-KI-RAS ONCOGENES IN LIVER NEOPLASMS OF WINTER FLOUNDER FROM BOSTON HARBOR,
Massachusetts Inst. of Tech., Cambridge. Dept. of Applied Biological Sciences.
G. McMahon, L. J. Huber, M. J. Moore, J. J. Stegeman, and G. N. Wogan.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 299-303. 1 fig, 1 tab, 16 ref. USPHS grant CA-44306.

Descriptors: *Toxic wastes, *Carcinogens, *Flounder, *Fish diseases, *Boston Harbor, *Hydrocarbons, *Water pollution effects, Liver, Mutations, Deoxyribonucleic acid, Benzopyrenes, Aromatic hydrocarbons.

A study was conducted to determine (1) whether oncogenes could be identified in liver neoplasms isolated from feral fish from Boston Harbor and, (2) whether activating mutations in these oncogenes would correlate with the nucleotide specificity of polycyclic aromatic hydrocarbon-induced mutations. Genomic deoxyribonucleic acid isolated from liver samples was analyzed for the presence of transforming genes by deoxyribonucleic acid transfection into NIH3T3 mouse fibroblasts followed by selection for tumorgenicity in the Nu-Nu athymic mice. Deoxyribonucleic acid from 54% of flounder samples induced tumors in the Nu-Nu assay; analysis of the Nu-Nu tumors by Southern blot hybridization revealed the presence of c-Ki-ras oncogenes in 6 out of 7 deoxyribonucleic acids analyzed. Using polymerase chain reaction (PCR) followed by direct deoxyribonucleic acid sequence analysis of polymerase deoxyribonucleic acid, primary liver samples were analyzed for the presence of deoxyribonucleic acid sequence changes in the first exon of the flounder c-Ki-ras proto-oncogene. It was determined that a single G-T base transversion in the second position of the 12th codon (GLY to VAL) is present in a flounder sample which showed transforming activity. This technique is currently being applied to the analysis of proto-oncogenes and oncogenes from the Nu-Nu tumors to determine the activating mutation. Such a mutation is consistent with the mutagenic specificity of polycyclic aromatic hydrocarbons, such as benzo(a)pyrene and may indicate specific chemical exposure history. (See also W89-03595) (Author's abstract)
W89-03633

EVALUATION OF CANDIDATE MEASURES OF BIOLOGICAL EFFECTS FOR THE NATIONAL STATUS AND TRENDS PROGRAM,
National Ocean Service, Seattle, WA. Ocean Assessments Div.
E. R. Long, and M. F. Buchman.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 307-309.

Descriptors: *Fish diseases, *Organic compounds, *Toxic wastes, *Bioindicators, *Water pollution effects, *Bioassays, San Francisco Bay, Monitoring, Mortality, Fish behavior, Larval growth stage, Reproduction, Flounder.

The performance of candidate measures of biologic effects for possible inclusion in the National Status and Trends Program was evaluated in an experiment performed in San Francisco Bay in 1987. This program monitors the concentrations of selected contaminants at marine and estuarine sites nationwide. Five types of sediment bioassays were performed and the results evaluated relative to the concentrations of a mixture of contaminants at five sites. End-points included acute mortality, abnormal larval development, behavioral changes, reproductive success, and chromosome damage. Starry flounder from six sites were tested to determine hepatic mixed-function oxidase activity, hepatic cytochrome P-450 activity, plasma steroid hormone concentrations, incidence of plasma enthrocyte micronuclei and reproductive success. All the bioassays identified the most contaminated site as toxic with one or more end-points. All the tests performed on the starry flounder indicated that San Francisco Bay fish were exposed to higher contaminant concentrations than their counterparts from coastal reference sites. (See also W89-03595) (Miller-PTT)
W89-03634

ANALYSIS OF MUSKRAT POPULATIONS FOR BIOINDICATORS OF EXPOSURE TO CONTAMINANTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
R. S. Halbrook, and R. L. Kirkpatrick.
IN: Preprints of Papers Presented at the 196th

ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 311-312.

Descriptors: *Bioindicators, *Toxic wastes, *Water pollution effects, *Hydrocarbons, *Rivers, *Muskrats, Population exposure, Statistical analysis, Elizabeth River, Deoxyribonucleic acid, Aromatic compounds.

Sixty muskrats (40 from two locations in the Elizabeth River in southeastern Virginia and 20 from the Nansemond River, a nearby clean river which serves as a control) were collected and analyzed for a variety of physical and chemical indicators of exposure and adverse effects from polycyclic aromatic hydrocarbons. Pentobarbital induced sleep times were determined as an index to hepatic microsomal enzyme activity and were lower in the muskrats from the polluted region of the Elizabeth River indicating greater exposure to hepatic microsomal enzyme inducers there. Previous studies have indicated that pentobarbital induced sleep times decrease as the hepatic microsomal enzyme activities increase. An increase in hepatic microsomal enzyme activity has been observed with increased concentrations of polycyclic aromatic hydrocarbons. Statistical analysis (ANOVA) of 23 blood characteristics indicated a significant difference only between alkaline phosphate and calcium when blood from muskrats collected from Elizabeth River was compared to blood from muskrats collected from Nansemond River. Preliminary analyses also have indicted a significant decrease in body and liver weights in muskrats from the Elizabeth River compared to those from the Nansemond River. A higher rate of capture success in the most polluted portions of the Elizabeth River also has been noted. This may indicate a behavioral change; however, these data have yet to be quantified. An analysis of deoxyribonucleic acid adducts using P-32 postlabeling techniques and high performance liquid chromatography analysis of the bile for polycyclic aromatic hydrocarbon metabolites is in progress, as well as an analysis of the reproductive status and population densities within the research areas. (See also W89-03595) (Miller-PTT)
W89-03635

SUBLETHAL EXPOSURE OF EXTRACTED SEDIMENTS INDUCES HEPATIC CELLULAR ALTERATIONS IN MEDAKI, ORYZIAS LATIPES: AN ASSAY FOR TESTING THE PRESENCE OF CARCINOGENS,
Louisville Univ., KY. Dept. of Biology.
D. Chai, and S. M. Cormier.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 318-321. 6 ref.

Descriptors: *Bioassay, *Bioindicators, *Toxic wastes, *Sublethal effects, *Sediments, *Carcinogens, *Water pollution effects, *Fish diseases, *Hydrocarbons, Fish, Liver, Medaka, Population effects.

Medaka, Oryzias latipes, embryos and juveniles were exposed to single, short-term, low concentration treatments of one of two known carcinogens, Aflatoxin B1 or Arochlor 1254 (a polycyclic aromatic hydrocarbon), or to an extraction prepared from a river bottom sediment. Sediments were collected from six industrial sites near Pittsburgh, PA. Histopathological alterations of livers from fish exposed to sediment extracts were compared to positive control livers of Aflatoxin B1 and Arochlor 1254 exposed fish. Incidence of lipmatosis or spongiotic edema and multicellular cystic lesions were compared. Histopathologies were more frequently observed in the Aflatoxin B1 exposed fish than in those treated with Arochlor 1254. Fish treated with the sediment extract developed similar pathologies; thus, low level, short-term, one-time exposures can be a useful environmental assay. (See also W89-03595) (Author's abstract)
W89-03636

ANALYSIS OF BLOOD BIOMARKERS FROM BLUEGILL SUNFISH,
Western Carolina Univ., Cullowhee, NC.
C. E. Gettys, L. R. Shugart, and M. K. Gustin.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 357-358. DOE contract DE-AC05-840R21400.

Descriptors: *Bioindicators, *Toxic wastes, *Benzopyrenes, *Carcinogens, *Sunfish, *Fish, *Water pollution effects, Population exposure, Cytometry, Hydrocarbons, Aromatic compounds.

Changes in populations of peripheral blood cells as a result of exposure to benzo(a)pyrene were studied. Blood cell populations were examined in lab-reared sunfish (Lepomis machrochirus) following low level, chronic exposure to benzo(a)pyrene. The nuclei of peripheral blood cells were stained and examined by flow cytometry. Fish red blood cells are nucleated, thus all cell populations can be observed with this technique. Additionally, whole blood smears were prepared immediately after collection and are stained and observed microscopically for differential cell counts. Preliminary results of the flow cytometry indicate that variations in the blood cell populations can be correlated with exposure and return to control patterns with the cessation of exposure. Work is in progress to identify these changes in the cytograph patterns as they relate to the populations of peripheral blood cells. (See also W89-03595) (Author's abstract)
W89-03640

CHEMICAL ANALYSIS OF DISTRIBUTION AND MARKETING (D AND M) MUNICIPAL SLUDGES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5E.
W89-03642

AUTOMATED DATA ACQUISITION AND ANALYSIS: APPLICATION TO THE DETERMINATION OF VOLATILE ORGANIC CONTAMINANTS IN GROUNDWATER,
S-Cubed, La Jolla, CA.
V. Taylor, L. E. Michalec, J. D. Wander, and K. Denblyker.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 368.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Pollutant analysis, *Groundwater pollution, *Computers, *Automation, *Gas chromatography, Organic compounds, Groundwater, Data acquisition.

A gas chromatographic software package was designed and developed to provide unattended determination of volatile organic compounds in groundwater. The menu driver software was designed for use by non-technical operators and includes both novel peak processing capabilities as well as built-in quality assurance/quality control protocols. The system may be calibrated with up to 14 volatile organic compounds and the results of this calibration used for quantification of subsequent samples. Resident data quality assurance and quality control protocols track system performance by requiring analysis of daily standards and periodic matrix spike and spike duplicate analysis. The accuracy and precision of the results in terms of percent recovery and relative standard deviation are referenced to predetermined acceptance criteria and operators are warned when these control limits are exceeded. The results of all quality assurance and quality control sample analysis are automatically used for preparation of system control charts. (See also W89-03595) (Author's abstract)
W89-03643

MONITORING THE DEGRADATION PRODUCTS OF PETROLEUM HYDROCARBONS IN SOIL GAS AND GROUNDWATER,
For primary bibliographic entry see Field 5B.
W89-03647

STUDY OF ORGANIC PEROXIDE PRODUCED FROM THE OZONATION OF HEXADEC-9-ENOIC ACID (HDA) IN WATER,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 5F.
W89-03651

ION EXCHANGE-SPECTROPHOTOMETRIC DETERMINATION OF PPB AND SUB-PPB CD,
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
V. Cheam, and E. X. Li.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 416-420. 2 fig, 3 tab, 12 ref.

Descriptors: *Spectrophotometry, *Cadmium, *Pollutant identification, *Ion exchange, *Detection limits, Copper, Manganese, Automation, Cobalt, Water analsysi, Chemical analysis.

A sensitive ion chromatographic method has been developed for the determination of low- and sub-ppb cadmium in dilute water samples preserved with 0.2% HNO3. The detection limit of 0.1 ppb satisfies the various guidelines and objectives of 0.2 ppb cadmium. The method is also applicable to the determination of cobalt and manganese down to 0.1 ppb. The automation, on-line concentration and simultaneous determination is an advantage over the flame and furnace AA. (See also W89-03595) (Author's abstract)
W89-03653

PHYSICAL AND CHEMICAL METHODS FOR THE CHARACTERIZATION OF HAZARDOUS WASTES,
Oak Ridge National Lab., TN.
C. W. Francis, M. P. Maskarinec, and D. W. Lee.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-005441. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-880343--1, (1987). 27p, 1 fig, 3 tab, 29 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Chemical analysis, *Pollutant identification, *Landfills, *Leaching, *Hazardous wastes, *Fate of pollutants, Toxicity, Path of pollutants, Model studies, Physical plant.

Numerous test methods have been proposed and developed to evaluate the hazards associated with handling and disposal of wastes in landfills. The major concern is the leaching of toxic constituents from the wastes. The fate of hazardous constituents in landfilled wastes is highly dependent on the physical and chemical characteristics of the waste. Thus, the primary objective in the selection of waste characterization procedures should be focused on those methods that gage the fate of the waste's hazardous constituents in a specific landfill environment. Waste characterization in the United States has centered around the characteristics of ignitability, corrosivity, reactivity, and toxicity. The strategy employed in the development of most regulatory waste characterization procedures has been a pass or fail approach, usually tied to some form of a mismanagement scenario for that waste. For example, USEPA has chosen the disposal of a waste in a municipal waste landfill as a mismanagement scenario for the development of the waste leaching tests to determine the toxicity characteristic. Many wastes, such as large-volume utility wastes or mining wastes, are not disposed of in municipal waste landfills. As a consequence, more effort is needed in the development of waste leaching tests that determine the long-term leaching characteristics of that waste in the landfill environment in which the waste is to be disposed. Waste leaching models also need to be developed and tested as to their ability to simulate actual disposal environments. These models need to be compared with laboratory leaching waste tests, and, if practical, coupled with groundwater transport models. (Author's abstract)
W89-03731

INSTALLATION RESTORATION PROGRAM. PHASE I - RECORDS SEARCH, AIR FORCE PLANT NO. 26, OHIO.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-03748

INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 6, GEORGIA.
CH2M Southeast, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W89-03750

INSTALLATION RESTORATION PROGRAM. PHASE I - RECORDS SEARCH, MCCONNELL AFB, KANSAS.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-03751

DETERMINATION OF BARIUM IN BOTTLED DRINKING WATER BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Ferrara Univ. (Italy). Lab. of Analytical Chemistry.
F. Fagioli, C. Locatelli, E. Lanciotti, G. Valone, and D. Mazzotta.
Analytical Letters ANALBP, Vol. 21, No. 11, p 2107-2116, November 1988. 1 fig, 3 tab, 19 ref.

Descriptors: *Pollutant identification, *Barium, *Drinking water, *Atomic absorption spectrophotometry, Detection limits, Italy, Public health, Calibration.

In relation to the wide environmental spread of barium and to its cardiovascular effects, barium levels were determined by graphite furnace atomic absorption spectrometry in 60 different brands of bottled water marketed in Italy. Matrix interferences were investigated in order to evaluate the use of an analytical calibration function rather than the much more time-consuming addition technique. The barium content ranged from limit of detection (7.0 micrograms/liter) up to 660 micrograms/liter, the median value being 80 micrograms/liter, while the recovery tests varied between 90 and 100% and the precision of the method was 2.5%. (Author's abstract)
W89-03839

ASIATIC CLAM, CORBICULA FLUMINEA: AN INDICATOR OF TRACE METAL POLLUTION IN THE SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Dept. of Environmental Marine Chemistry.
J. K. Abaychi, and Y. Z. Mustafa.
Environmental Pollution ENPOEK, Vol. 54, No. 2, 109-122, 1988. 1 fig, 5 tab, 30 ref.

Descriptors: *Water pollution effects, *Clams, *Bioindicators, *Trace metals, *Heavy metals, *Stream pollution, Water pollution, Water quality, Iraq, Rivers, Metals, Atomic absorption spectorscopy, Seasonal variation, Asiatic clam.

The potential of Corbicula fluminea (Muller) as an indicator for trace metal pollution was investigated. Laboratory experiments show that Corbicula has the capability to accumulate and eliminate trace metals in relation to their concentrations in ambient water. However, an effect of individual size was observed. Seasonal variations in the concentrations of Cd, Co, Cu, Fe, Mn, Ni, Pb, V and Zn in Corbicula, water and particulate matter from the upper section of the Shatt al-Arab River were studied. Sediment samples were also analyzed. Metal concentrations were determined by means of flameless atomic absorption spectroscopy (AAS). It was found that Corbicula is a suitable bio-indicator for monitoring of trace metal pollution. Metal concentrations in Corbicula tissues correlated better with their corresponding concentrations in particulate matter than with the dissolved form. Temporal variations in metal concentrations were attributed to several factors, including fluctuations in metal inputs, and in geochemical and hydrological characteristics of the water. The obtained levels of trace metals were comparable to those reported for control sites, with the exception of Cd, Cu and Zn whose concentrations were higher in both Corbicula and particulate matter. (Author's abstract)
W89-03872

USING HEADSPACE SAMPLING WITH CAPILLARY COLUMN GC-MS TO ANALYZE TRACE VOLATILE ORGANICS IN WATER AND WASTEWATER,
Alaska Univ., Anchorage. Dept. of Chemistry.
D. E. Gryder-Boutet, and J. M. Kennish.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 52-55, October 1988. 4 fig, 5 tab, 7 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Gas chromatography, *Mass spectrometry, Trace levels, Volatility, Organic compounds, Sampling, Pollutants.

Headspace sampling combined with capillary column gas chromatography-mass spectrometry analysis was evaluated for use in the investigation of priority pollutants in water and wastewater. A 3 mL sample loop and cryogenic trapping at -80 C were employed to increase the sensitivity into the nanogram-per-liter range, and excellent reproducibility was found in the low microgram-per-liter range. Separations were accomplished with a coated 30-m X 0.32-mm fused silica capillary column. Mass spectral data were acquired by selective ion monitoring form 50 to 500 amu. The method was applied to water and wastewater samples with good results. Though the technique is not currently certified by the EPA, it could be readily applied to rapid sample screening for contamination surveys or initial investigations. (Author's abstract)
W89-03889

EVALUATION OF A CARBON ADSORPTION METHOD FOR SAMPLING GASOLINE VAPORS IN THE SUBSURFACE,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. D. Wallingford, F. A. DiGiano, and C. T. Miller.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 85-92, Fall 1988. 7 fig, 2 tab, 7 ref. EPA Contract CR-812713-01-5.

Descriptors: *Sampling, *Activated carbon, *Groundwater pollution, Gasoline, *Pollutant identification, *Adsorption, Gas chromatography, Soil contamination, Monitoring.

Monitoring of the vapor phase has emerged as a very convenient method for detecting volatile organic contaminants in the subsurface. It can provide a reliable way of placing groundwater monitoring and recovery wells. The most common method uses a driveable ground probe (DGP) to extract a vapor-phase sample followed by direct injection of the vapor into a portable gas chromatograph (GC). However, many regional offices of regulatory agencies and consultants do not have ready access to such equipment. This research explores an alternative, the carbon adsorption method, in which the vapor is withdrawn by the DGP but concentrated on a small activated carbon trap (150 mg). The carbon traps can be returned to a central laboratory for solvent extraction and GC analysis. This provides the advantages of increased sensitivity, reduction in field equipment and convenience of in-lab analyses (multiple GC injections are possible). A simple DGP and carbon trap system was constructed and tested at a field site. Vapor-phase concentrations of target compounds present in gasoline were mapped quite conveniently, ranging from 10,000 micrograms/liter (vapor phase) to less than 10 micrograms/liter. These concentrations were also shown to decrease in the direction of the ground surface, as expected. Measurements of target compounds in soil showed that the vapor phase contributed a large fraction of the total contaminant burden where a non-aqueous-phase layer (NAPL) had been identified; as important, however, is the rather uniform contamination of the soil outside the NAPL region. Finally, the concentrations of target compounds in the vapor phase and groundwater could be related in a manner roughly described by a simple equilibrium model, although exceptions were noted. (Author's abstract)
W89-03923

INEXPENSIVE, MULTI-USE, DEDICATED PUMP FOR GROUND WATER MONITORING WELLS,
Gartner Lee Associates Ltd., Markham (Ontario).
For primary bibliographic entry see Field 7B.
W89-03925

EVALUATION OF SOME SYSTEMS FOR SAMPLING GAS-CHARGED GROUND WATER FOR VOLATILE ORGANIC ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W89-03927

MODELING GROUND WATER QUALITY SAMPLING DECISIONS,
National Taiwan Univ., Taipei. Dept. of Environmental Science.
For primary bibliographic entry see Field 7A.
W89-03928

STATISTICAL ISSUES AND PROBLEMS IN GROUND WATER DETECTION MONITORING AT HAZARDOUS WASTE FACILITIES,
Toledo Univ., OH. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 7A.
W89-03929

BEHAVIOUR OF PESTICIDES IN LAKE KASUMIGAURA, JAPAN,
National Inst. for Environmental Studies, Yatabe (Japan).
For primary bibliographic entry see Field 5B.
W89-03941

CORRELATION CLUSTERS IN THE ACCUMULATION OF METALS IN HUMAN SCALP HAIR: EFFECTS OF AGE, COMMUNITY OF RESIDENCE, AND ABUNDANCE OF METALS IN AIR AND WATER SUPPLIES,
Simon Fraser Univ., Burnaby (British Columbia). School of Kinesiology.
For primary bibliographic entry see Field 5B.
W89-03942

DISTRIBUTION OF SILICONES IN WATER, SEDIMENT AND FISH IN JAPANESE RIVERS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, H. Nagase, and Y. Ose.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 1-9, July 1, 1988. 8 fig, 6 tab, 3 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Polyorganosiloxanes, *Rivers, *Fish, *Sediments, *Silicone, Japan, Water pollution, Contamination, Solvents, Effluents, Sludge, Sampling, Chromatography, Chemical analysis, Water analysis, Emission spectroscopy, Industrial wastes, Polymers, Emission spectroscopy.

A new analytical method for assaying polyorganosiloxanes, (silicones), in environmental samples utilizes petroleum for solvent extraction of the sample (water, sediment, biological tissue) together with inductively coupled plasma detection of the extracted organic silicones. The detection limit for silicones in the final methyl isobutyl ketone sample/extract is approximately 0.01 ppm, and the method is applied to samples from various Japanese rivers to quantify silicones in several environmental materials. Silicones are reported from river waters, up to 50 ppb, riverine sediments, up to 6 ppm, and as an extractable component of fish tissue, up to 0.9 ppm. (Author's abstract)
W89-03949

HISTORICAL RECORDS OF SILICONES IN SEDIMENT,
Naval Research Lab., Washington, DC. Chemistry Div.
R. E. Pellenbarg.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 11-15, July 1, 1988. 5 fig, 1 tab, 8 ref.

Descriptors: *Sediments, *Silicones, *Polyorganosiloxanes, Chemical analysis, History, Infrared spectroscopy, Sampling, Aquatic environments, Polymers.

Polyorganosiloxanes, silicones, are totally synthetic polymeric materials that have seen increasing use since the Second World War. The use of silicones results in the release of these stable polymers to the environment, and data are presented which show measurable silicone (ppm level) in selected aquatic sediments. A new, sensitive method measures silicone by use of chloroform extraction of a small (1 gram or less) sample coupled with Fourier Transform IR spectroscopy. Using this method silicone is detected in a sediment column at a depth which corresponds to the onset of the widespread use of silicones. Thus, in very old sediment, there is no anthropogenic silicone, but contemporary surficial sediments exhibit silicone. (Author's abstract)
W89-03950

REVIEW OF THE BIOGEOCHEMISTRY OF GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W89-03954

METHOD FOR EVALUATING MUTAGENICITY OF WATER: I. A NEW METHOD OF PREPARING SAMPLES FOR MUTAGENICITY TEST,
Yokohama National Univ. (Japan).
K. Urano, N. Haga, F. Emoto, and T. Shinome.
Science of the Total Environment STENDL, Vol. 74, p 177-189, August 1, 1988. 15 fig, 5 tab, 14 ref.

Descriptors: *Water analysis, *Pollutant identification, *Sample preparation, *Mutagenicity, *Adsorbents, *Resins, Water quality, Organic compounds, Carcinogens, Solvents, Sampling, Drinking water.

A sample preparation method for a convenient and quantitative mutagenicity test of water was developed using two new superior resinous adsorbents. One, CSP800, is a small particle size and highly porous polystyrene resin, and the other, CHPA25, is a small particle size and highly porous anion-exchange resin. CSP800 adsorbed more nonionic compounds from water than conventional resins, and CHPA25 adsorbed anionic compounds not adsorbed by conventional resins. Sample water (10 l) at pH 5 was fed at 500 ml per hour into two columns in series, one containing 5 ml of SCP800 and the other 2 ml of CHPA25. The adsorbed substances were subsequently desorbed by DMSO from CSP800 and by 4 N NaNO3 from CHPA25, at 10 ml per hour. Various organic substances, which were measured by different indices such as total trihalomethanes, total organic halogen and the absorbence at 260 nm, could be recovered by this method much more efficiently and conveniently than by conventional methods. (See also W89-03964) (Author's abstract)
W89-03963

METHOD FOR EVALUATING MUTAGENICITY OF WATER: II. CONDITIONS FOR APPLYING NEW SAMPLE PREPARATION METHOD TO THE AMES TEST,
Yokohama National Univ. (Japan).
K. Urano, N. Haga, and F. Emoto.
Science of the Total Environment STENDL, Vol. 74, p 191-198, August 1, 1988. 2 fig, 5 tab, 3 ref.

Descriptors: *Water analysis, *Pollutant identification, *Sample preparation, *Mutagenicity, *Ames test, Water quality, Adsorbents, Resins, Organic compounds, Drinking water, Pollutants, Solvents, Sampling, Ion exchange.

Conditions for the application of a new sample preparation method developed in a previous study using the small particle size and highly porous polystyrene and anion-exchange resins CSP800 and CHPA25 were investigated. The desorbing solvents DMSO and 4 N NaNO3 (0.5 ml), corresponding to 11 of water sample, could be dosed on a plate for the mutagenicity test, the Ames test. It was confirmed that trace impurities from the resins were not mutagenic. The mutagenicity of several drinking water samples was determined by this new method and evaluated quantitatively by converting to the concentration of the standard mutagens, 4-nitroquinoline-1-oxide and 2-aminoanthracene, without S9 and with S9 respectively. Furthermore, the mutagenicity of the nonionic pollutants adsorbed on CSP800 and that of anionic pollutants adsorbed on CHPA25 could be evaluated separately. (See also W89-03963) (Author's abstract)
W89-03964

TRACE ELEMENT RESIDUES IN BLUEGILLS AND COMMON CARP FROM THE LOWER SAN JOAQUIN RIVER, CALIFORNIA, AND ITS TRIBUTARIES,
National Fisheries Contaminant Research Center, Dixon, CA. Field Research Station-Dixon.
For primary bibliographic entry see Field 5B.
W89-03965

CONTINUOUS POLIOVIRUS DETECTION IN WATER SUPPLY DISTRIBUTION NETWORKS (DETECTION EN CONTINU DU POLIOVIRUS DANS DES EAUX DE DISTRIBUTION PUBLIQUE),
Service de Controle des Eaux de la Ville de Paris (France).
For primary bibliographic entry see Field 5F.
W89-03988

ATOMIC ABSORPTION SPECTROMETRIC AND SPECTROPHOTOMETRIC TRACE ANALYSIS OF INDIUM IN ENVIRONMENTAL SAMPLES,
Pondicherry Univ. (India). Salim Ali School of Ecology.
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 21, No. 9, p 1705-1721, September 1988. 2 fig, 4 tab, 17 ref.

Descriptors: *Atomic absorption spectroscopy, *Spectrophotometry, *Trace elements, *Chemical analysis, *Pollutant identification, *Indium, *Water analysis, Photometry, Chloroform, Metallurgy, Wastes, Industrial wastes, Sample preparation, Reagents, Solvents, Calibrations, Tissue analysis.

The use of spectrometry and spectrophotometry was investigated for the detection of indium, which is likely to be a part of certain industrial waste discharges. Indium (III) was selectively extracted at pH 5.2-5.9 with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA) into chloroform. BPAR (5-bromo-4(2-pyridylazo) resorcinal) was added to the extract to form an intensely red-colored ternary complex measurable spectrophotometrically at 515 nm. The extraction system enabled enrichment of indium and determination of the metal down to 0.1 ppb levels. For atomic absorption spectrometric determination, indium was extracted with MFHA into methyl isobutyl ketone and measured at 303.9 nm resonance line in the air-acetylene flame. Both the methods were successfully applied to the determination of indium in ore, animal/plant tissue, and natural waters. The MFHA-BPAR reagent combination was chosen from a study of 11 new hydroxamic acids and nine pyridylazo reagents. (Author's abstract)
W89-03998

ENVIRONMENTAL ANALYSIS OF THORIUM (IV) BY EXTRACTIVE SEPARATION WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND SPECTROPHOTOMETRIC DETERMINATION WITH 4-(2-PYRIDYLAZO) RESORCINOL,
Pondicherry Univ. (India). Salim Ali School of Ecology.
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 21, No. 9, p 1723-1734, September 1988. 4 tab, 26 ref.

Descriptors: *Waste analysis, *Tissue analysis, *Chemical analysis, *Separation techniques, *Pollutant identification, *Thorium, *Spectrophotometry, Photometry, Anions, Cations, Sample preparation, Wastes, Industrial wastes, Reagents.

Thorium (IV) was separated from several anions and cations commonly associated with it in environmental samples by liquid-liquid extraction with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA) into chloroform at pH 3.6-5.5. The metal was then back-extracted into aqueous media containing 1.8-2.2 M HCl and determined spectrophotometrically at 500 nm with 4-(2-pyridylazo) resorcinol (PAR). The method was successfully applied to the analysis of thorium in coal fly ash, monazite, uranium-thorium ore, animal tissue, plant tissue, and natural waters. MFHA and PAR were chosen from 13 hydroxamic acids and nine pyridylazo reagents as the reagent combination that provided the maximum selectivityand sensitivity. (Author's abstract)
W89-03999

FORMATION OF CHLORINATED AND BROMINATED ARTIFACTS DURING EXTRACTION OF DRINKING WATER WITH DICHLOROMETHANE,
Ontario Ministry of the Environment, Rexdale.
D. T. Wang, O. Meresz, V. Y. Taguchi, S. W. D. Jenkins, and D. Robinson.
Analytical Letters ANALBP, Vol. 21, No. 9, p 1749-1756, September 1988. 2 tab, 3 ref.

Descriptors: *Drinking water, *Chemical analysis, *Pollutant identification, *Chlorinated hydrocarbons, *Water analysis, Bromine hydrocarbons, Chemical reactions, Gas chromatography, Mass spectrometry, Reagents.

The formation of halogenated compounds during the extraction of chlorinated water with dichloromethane was studied. An 800 ml water sample was transferred into a separatory funnel and concentrated sulfuric acid or 6N sodium hydroxide was added to adjust the sample to pH 2 or 12, respectively. The sample was then extracted serially with three portions of dichloromethane. The combined extracts were concentrated to 200 microliters and analyzed by gas chromatography/mass spectrometry. The main component of the artifacts formed during extraction was identified as bromocyclohexanol. Other chlorinated and brominated cyclohexene derivatives were also formed. Investigation confirmed that the dichloromethane used in the study was contaminated with cyclohexene, added by the manufacturer at 200 ppm as a preservative. Chlorocyclohexanol is the major compound formed during extraction of residual chlorine-containing water samples. The brominated cyclohexene derivatives were formed only when the water sample contained bromide ions as well as chlorine. It is concluded that chlorinated water samples should be designated as reactive samples. To eliminate artifact formation, cyclohexene-free or totally preservative-free dichloromethane should be used for the extraction of such samples. (Doria-PTT)
W89-04000

STUDY OF VIBRIO ANGUILLARUM STRAINS FROM DIFFERENT SOURCES WITH EMPHASIS ON ECOLOGICAL AND PATHOBIOLOGICAL PROPERTIES,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
For primary bibliographic entry see Field 6G.
W89-04006

SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHORUS IN RIVER WATER BASED ON THE REACTION OF VANADOMOLYBDOPHOSPHATE WITH MALACHITE GREEN,
Okayama Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.

W89-04008

LASER-ENHANCED IONIZATION AS A SELECTIVE DETECTOR FOR THE LIQUID CHROMATOGRAPHIC DETERMINATION OF ALKYLTINS IN SEDIMENT,
Maryland Univ., College Park. Dept. of Civil Engineering.
K. S. Epler, T. C. O'Haver, G. C. Turk, and W. A. MacCrehan.
Analytical Chemistry ANCHAM, Vol. 60, No. 19, p 2062-2066, October 1, 1988. 5 fig, 48 ref. NOAA grant NA86AANGO163.

Descriptors: *Marine sediments, *Chromatography, *Lasers, *Ionization, *Metal organic pesticides, *Pollutant identification, *Tin, Chemical analysis, Pesticides, Organic pesticides, Heavy metals, Sample preparation, Detection limits, Cation exchange, Ion exchange, Reagents.

The combination of liquid chromatography with laser-enhanced ionization spectroscopy, using a flame as an atom reservoir, was applied to the determination of trialkyltin in sediment. The liquid chromatography separates the organotins and resolves spectral interferences from the analytes. A rapid method for extracting tributyltin from sediment into 1-butanol is described. The detection limit is 3 ng/ml tin as tributyltin or 0.06 ng of tin. The relative complexity of the required laser instrumentation is a drawback, but is compensated for by the simplicity of the sediment sample preparation, making the overall method suitable for large-scale survey work. More work is required to determine if the 1-butanol extraction procedure is suitable for a wide variety of sediment types. (Doria-PTT)
W89-04025

DETERMINATION OF NONVOLATILE ORGANIC COMPOUNDS IN AQUEOUS ENVIRONMENTAL SAMPLES USING LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
T. A. Bellar, and W. L. Budde.
Analytical Chemistry ANCHAM, Vol. 60, No. 19, p 2076-2083, October 1, 1988. 3 fig, 5 tab, 20 ref.

Descriptors: *High-performance liquid chromatography, *Water analysis, *Mass spectrometry, *Organic compounds, *Pollutant identification, Sample preparation, Detection limits, Calibrations, Organic pesticides, Carbamate pesticides.

A high-performance liquid chromatography (HPLC) separation procedure was developed and retention data collected for 52 pesticides and other compounds of environmental interest. The target analytes were identified and measured by directing the HPLC effluent through a thermospray (volatile salt ionization (VSI)) interface to a quadrupole mass spectrometer (MS). A liquid-liquid extraction (LLE) procedure and a liquid-solid extraction (LSE) procedure were used before the HPLC/VSI-thermospray/MS separation and measurement to obtain total method precision and accuracy data for 29 of the target analytes in reagent water. With LLE, the grand mean measurement accuracy of the 29 compounds was 71% with a mean relative standard deviation (RSD) of 11%. With LSE, the grand mean measurement accuracy of the 29 compounds was 76%, with a mean RSD of 17%. (Author's abstract)
W89-04026

SOLUTION-CHEMISTRY MODEL OF THE INTERFERENCE OF CADMIUM-CARBONATE PRECIPITATION IN THE DETERMINATION OF CATION-EXCHANGE SEPARATION FACTORS,
Geological Survey, Lakewood, CO. Water Resources Div.
R. L. Miller, D. B. Grove, and K. G. Stollenwerk.
Available from Supt. of Docs, GPO, Washington, D. C. 20402. In: USGS Water Supply Paper 2262, 1984. p 33-41, 5 fig, 3 tab, 15 ref.

Descriptors: *Chemical precipitation, *Water chemistry, *Water analysis, *Cadmium, Chemical reactions, Heavy metals, Chemical wastes, Cation exchange, Solute transport, Ion exchange.

A computer model combining the equilibria for cadmium-calcium ion exchange and precipitation of cadmium carbonate simulates experimentally determined sorption curves. Results show that carbon dioxide in air, and carbonates in sand samples and reagents may interfere with the determination of cation-exchange separation factors, because of cadmium carbonate precipitation. The magnitude of this interference depends on solution pH and ionic strength. When precipitation of cadmium carbonate is not considered, calculated values of cation-exchange separation factors appear several orders of magnitude greater than their correct value. (USGS)
W89-04100

RISK-BASED SELECTION OF MONITORING WELLS FOR ASSESSMENT OF AGRICULTURAL CHEMICAL CONTAMINATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-04127

RECORDS OF WELLS AND CHEMICAL ANALYSES OF WATER FROM WELLS FOR THE PERIOD JUNE 13, 1984 TO DECEMBER 4, 1986 AT THE MAXEY FLATS RADIOACTIVE WASTE DISPOSAL SITE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-04144

HYDROLOGIC DATA FROM THE INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS, NEW YORK - OCTOBER 1977 THROUGH JANUARY 1982,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04161

DESCRIPTION AND HYDROGEOLOGIC EVALUATION OF NINE HAZARDOUS-WASTE SITES IN KANSAS, 1984-86,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04171

EFFECT OF SUBLETHAL CONCENTRATIONS OF COPPER ON THE CRITICAL THERMAL MAXIMA (CTMAX) OF THE FANTAIL (ETHEOSTOMA FLABELLARE) AND JOHNNY (E. NIGRUM) DARTERS,
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-04248

QUANTITATION OF CHEMICALLY INDUCED DAMAGE TO DNA OF AQUATIC ORGANISMS BY ALKALINE UNWINDING ASSAY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-04252

PHENOL AND SULFIDE INDUCED CHANGES IN THE OVARY AND LIVER OF SEXUALLY MATURING COMMON CARP, CYPRINUS CARPIO,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-04253

DETERMINATION OF CALCIUM IN WATER BY FLOW INJECTION ANALYSIS - INDUCTIVELY COUPLED PLASMA (FIA-ICP) EMISSION SPECTROMETRY,
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2K.
W89-04287

EVALUATION OF VOLTAMMETRIC TITRATION PROCEDURES FOR THE DETERMINATION OF TRACE METAL COMPLEXATION IN NATURAL WATERS BY USE OF COMPUTER SIMULATION,
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 7B.
W89-04288

DETERMINATION OF NANOMOLAR LEVELS OF NITRITE IN FRESH AND SEA WATER BY CATHODIC STRIPPING VOLTAMMETRY,
Liverpool Univ. (England). Oceanography Lab.
For primary bibliographic entry see Field 2K.
W89-04289

FLUORESCENCE QUENCHING MEASUREMENTS OF COPPER-FULVIC ACID BINDING,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2K.
W89-04290

PHOTOCHROMISM-INDUCED PHOTOACOUSTIC SPECTROMETRY FOR THE DETERMINATION OF TRACE MERCURY(II) AS ITS DITHIZONATE IN THE SOLID STATE,
Carleton Univ., Ottawa (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W89-04291

USE AND MISUSE OF QUANTITATIVE DETERMINATIONS OF ENTEROBACTERIACEAE IN FOOD MICROBIOLOGY,
Nestle Products Technical Assistance Co. Ltd., Vevey (Switzerland). Quality Assurance Dept.
L. J. Cox, N. Keller, and M. van Schothorst.
Journal of Applied Bacteriology JABAA4, Vol. 65, Symposium Supplement, p 237S-249S, 1988. 12 tab, 35 ref.

Descriptors: *Microbiological studies, *Bioindicators, *Bacterial analysis, *Water quality, *Water quality standards, Aquatic bacteria, Pathogenic bacteria, Enterobacter, Escherichia coli, Enteric bacteria, Food microbiology, Food processing.

Bacteria belonging to the Enterobacteriaceae commonly form a part of microbiological criteria and their presence is traditionally related to hygiene and safety of foods. This use of these bacteria has been a logical sequel to their successful use in the field of water quality. This success has been based on the belief that the presence of certain Enterobacteriaceae indicate the possible presence of pathogens. Recent studies have indicated more complex situations occur in natural systems. Therefore, a thorough understanding of the microbial ecology of the system from source to consumer is essential. The real significance of Enterobacteriaceae as food contaminants can be understood only by having a thorough knowledge of the microflora of the production environment and the process. This information can only be obtained by monitoring the environment and critical points in a process continuously, using tests for Enterobacteriaceae and specific tests for pathogens. Lists of appropriate and inappropriate use of Enterobacteriaceae tests in food processing and water quality are provided, e.g., the presence in untreated water of Enterobacteriaceae able to grow at 44-45C probably indicates that fecal contamination has occurred; their presence in treated water does not necessarily indicate a hazard but needs investigating; and their absence does not necessarily indicate safety. (White-Reimer-PTT)
W89-04294

CHEMICAL CHARACTERIZATION AND MUTAGENIC PROPERTIES OF POLYCYCLIC AROMATIC COMPOUNDS IN SEDIMENT FROM TRIBUTARIES OF THE GREAT LAKES,
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5B.
W89-04327

SCREENING AND BIOMONITORING OF INDUSTRIAL EFFLUENTS USING PHYTOTOXICITY TESTS,
Illinois State Water Survey Div., Peoria. Water Quality Section.
W. Wang, and J. M. Williams.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 8, p 645-652, August 1988. 1 fig, 4 tab, 27 ref.

Descriptors: *Toxicity, *Toxicology, *Water pollution effects, *Industrial wastewater, *Phytotoxicity, *Duckweed, *Monitoring, Screening, Germination, Effluents, Ecotoxicity testing, Cabbage, Cucumber, Millet, Japanese millet, Rice, Wheat, Bioassay, Chlorosis, Necrosis.

The use of phytotoxicity (higher plant) tests as a part of ecotoxicology is relatively underdeveloped. Phytotoxicity tests for screening and biomonitoring complex effluent samples were evaluated. Mortality tests using common duckweed and seed germination tests were conducted using eight effluent samples collected from three industrial sources: an industrial wastewater pretreatment facility that specialized in treating wastewaters from a heavy machinery plant; an agricultural product utilization plant; and a specialty chemical plant. All eight samples were part of the influent entering the Greater Peoria Sanitary District sewage treatment plant. Duckweed plants were found to be extremely sensitive to two effluents (both from the agricultural product utilization plant), with nearly 100% mortality occurring. Duckweed plants in some samples showed lesions (breakup of colony structure) and loss of green pigments (chlorosis); others showed localized dead tissues (necrosis). Six kinds of seeds were tested: cabbage, cucumber, millet, Japanese millet, rice and wheat. Cabbage and millet seeds were the most sensitive. The germination of these seeds was 100% inhibited in some samples. The results suggest that phytotoxicity test with higher plants have potential for use in the biomonitoring of industrial effluents because of their simplicity, sensitivity, and cost effectiveness. (Davis-PTT)
W89-04334

APPLICATION OF CELLULOLYTIC ACTIVITY OF ASIATIC CLAMS (CORBICULA SP.) TO IN-STREAM MONITORING OF POWER PLANT EFFLUENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. L. Farris, J. H. Van Hassel, S. E. Belanger, D. S. Cherry, and J. Cairns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9, p 701-713, September 1988. 4 fig, 2 tab, 48 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Heavy metals, *Monitoring, *Powerplants, *Effluents, *Bioassay, Artificial streams, Clams, Virginia, Cellulase, Copper, Zinc, Enzymes.

Rigorous testing schemes in field located artificial streams and in-stream monitoring provided evidence for the use of Corbicula cellulolytic activity as a highly sensitive and efficient approach to effluent assessment. Cellulolytic (exo- and endocellulase) activity of the Asiatic clam, Corbicula sp., determined in 30-day, field located artificial stream exposure at New River, Virginia to single components of power plant effluents (Cu, and Zn, separately) was compared with cellulolytic responses in caged clams from within an impacted area of the Clinch River, Virginia below power plant effluents. Cellulolytic responses were compared to conventional biomonitoring responses (Hester-Dendy macroinvertebrate community structure), water quality monitoring in the Clinch River, and laboratory artificial stream bioassays. Clam enzyme activity was significantly reduced in 10 to 20 days at 16 and 87 micrograms Cu and Zn/L, respectively, in field located artificial streams. Cellulolytic activity of clams caged at stations within power plant outfalls was significantly reduced to levels as low as 9 to 52% of upstream activity levels. Reduction in cellulolytic activity in Corbicula was more sensitive after 14 days of in-stream monitoring than reduction in diversity of macroinverbtebrate assemblages after 28 days. Bioassay exposures as long as 30 days were needed to provide toxicity data comparable to enzyme impairment seen as early as ten days. (Author's abstract)
W89-04337

SIMPLE, SPECIFIC ANALYSIS OF ORGANOPHOSPHORUS AND CARBAMATE PESTICIDES IN SEDIMENTS USING COLUMN EXTRACTION AND GAS CHROMATOGRAPHY,
Patuxent Wildlife Research Center, Laurel, MD.
A. A. Belisle, and D. M. Swineford.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9, p 749-752, September 1988. 3 tab, 13 ref.

Descriptors: *Pollutant identification, *Pesticides, *Sediments, *Gas chromatography, Organophosphates, Carbamates, Column extraction, Chromatography , Soil analysis.

A simple, specific procedure was developed for the analysis of organophosphorus and carbamate pesticides in sediment. The wet soil was mixed with anhydrous sodium sulfate to bind water and the residues were column extracted in acetone:methylene chloride (1:1,v/v). Coextracted water was removed by additional sodium sulfate packed below the sample mixture. The eluate was concentrated and analyzed directly by capillary gas chromatography using phosphorus and nitrogen specific detectors. Recoveries averaged 93% for sediments extracted shortly after spiking, but decreased significantly as the samples aged. (Author's abstract)
W89-04340

COMPARISON OF PROCEDURES FOR RECOVERING CHLOROGUAIACOLS AND CHLOROCATECHOLS FROM CONTAMINATED SEDIMENTS,
Swedish Environmental Research Inst., Stockholm.
M. Remberger, P.-A. Hynning, and A. H. Neilson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 795-805, October 1988. 1 fig, 5 tab, 57 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Chlorinated hydrocarbons, *Sediments, *Solvents, Contamination, Sediment analysis, Chlorocatechols, Chloroguaiacols, Chlorovanillins, Xenobiotics, Desorption, Sampling.

Procedures for the extraction of chloroguaiacols and chlorocatechols from contaminated sediment samples were examined. Using one sample, a comparison was made of the following procedures: solvent extraction with water-miscible solvents, steam distillation, Soxhlet extraction with t-butyl methyl ether, and several more aggressive methods employing BF3/methanol, HBr/water and KOH/methanol. The recoveries of the chlorinated compounds were highly variable. Recovery of the chloroguaiacols by the nonaggressive procedures was generally low, but it was significantly greater using methanolic alkali. The efficacy of the latter procedure was confirmed by the data obtained with three other sediment samples. Qualitatively similar differences in recoverability were also observed when a high molecular weight alkali-stage chlorolignin was examined. It was not possible to determine whether the monomeric chlorinated compounds were bound to natural organic compounds in the sediment or to the chlorolignin, which is produced during the bleaching process. In an experiment using one sediment sample incubated under anaerobic conditions for nine months, no change occurred in the amount of extractable chloroguaiacols and there was an approximate 40% reduction in the corresponding chlorocatechols. It is postulated that the binding mechanisms of the chloroguaiacols and chlorocatechols in the sediment phase are significantly different, and that an indeterminate fraction is not accessible to microbial transformation. There are inherent limitations to interpreting the results of experiments on binding and desorption in which xenobiotics are exposed to the sediment phase for only a short time. (Author's abstract)
W89-04343

PORPHYRIA IN HERRING GULLS: A BIOCHEMICAL RESPONSE TO CHEMICAL CONTAMINATION OF GREAT LAKES FOOD CHAINS,
National Wildlife Research Centre, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W89-04346

ENVIRONMENTAL ASSESSMENT OF PESTICIDES - A CONCEPTUAL APPROACH,
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-04353

PROPOSED METHOD FOR CALCULATING TAXONOMIC-GROUP-SPECIFIC VARIANCES FOR USE IN ECOLOGICAL RISK ASSESSMENT,
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
J. Volmer, W. Kordel, and W. Klein.
Chemosphere CMSHAF, Vol. 17, No. 8, p 1493-1500, 1988. 1 fig, 2 tab, 4 ref.

Descriptors: *Analysis of variance, *Toxicity, *Risk assessment, *Statistics, *Environmental impact, *Ecological effects, Taxonomy, Statistical analysis, Toxicology, Invertebrates, Probabilistic process, Lethal limit, Fish.

A method for calculating variances for toxicological parameters, in particular, for LC50 values is presented as one possible increment of risk assessment. It is based on the statistical analysis of several substance-specific data subsets containing at least three data values per chemical for the taxonomic group of interest. For example, when analyzing homogeneous data, for bony fishes a mean variance value of 0.12 log units was found, whereas analysis of interlab data yielded a value of 0.23. Extending these studies to freshwater invertebrates resulted in a much greater variance value, namely 0.5. Further studies dealing with the variance of benchmark concentrations other than LC50 are in progress. (Author's abstract)
W89-04355

GROUNDWATER QUALITY: A DATA ANALYSIS PROTOCOL,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. C. Ward, J. C. Loftis, H. P. DeLong, and H. F. Bell.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1938-1945, November 1988. 10 fig, 1 tab, 15 ref.

Descriptors: *Data analysis protocols, *Water quality, *Runoff, *Groundwater pollution, *Groundwater, Statistical analysis, Graphical analysis, Graphical methods, Data acquisition, Water quality control, Monitoring, Water quality management, Industrial wastewater.

Data analysis protocols (DAPs) are used for groundwater quality monitoring. The DAP described in this paper was developed from the perspective of regulated industrial facilities. The protocol focuses on average, changing, and extreme conditions in groundwater quality. Statistical procedures are selected based on the current understanding of the general characteristics of groundwater quality variables. A summary and reporting format is suggested to plot information into a form easily and quickly readable by managers. DAP will continue to play an increasing role in monitoring groundwater quality. (Stoehr-PTT)

W89-04368

MICROORGANISM LEVELS IN AIR NEAR SPRAY IRRIGATION OF MUNICIPAL WASTEWATER: THE LUBBOCK INFECTION SURVEILLANCE STUDY,
Southwest Research Inst., San Antonio, TX.
For primary bibliographic entry see Field 5E.
W89-04371

ANALYSIS OF LOW MOLECULAR WEIGHT ALDEHYDES CAUSING ODOUR IN DRINKING WATER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
S. A. Daignault, A. Gac, and S. E. Hrudey.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 583-588, July 1988. 3 fig, 1 tab, 12 ref.

Descriptors: *Water analysis, *Drinking water, *Water analysis, *Chemical analysis, *Odors, Low molecular weight aldehydes, Gas chromatography, Aldehydes.

Low molecular weight aldehydes have been quantitatively measured in distilled water at levels similar to their published threshold odor concentrations in drinking water by a simple and sensitive purge and trap method. Isobutyraldehyde, isovaleraldehyde and 2-methyl-butyraldehyde were isolated from aqueous samples by purge and trap onto Tenax-TA adsorbent. The aldehydes were thermally desorbed onto the head of a cryogenically cooled gas chromatography column and eluted by temperature programmed gas chromatography. The method has a linear range of 0.5 micrograms/l to 100 micrograms/l with an average precision of 10.9% relative standard deviation for the aldehydes studied. (Author's abstract)
W89-04395

POLLUTION SOURCE ANALYSIS OF RIVER WATER AND SEWAGE SLUDGE,
Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie.
For primary bibliographic entry see Field 5B.
W89-04413

MYTILUS EDULIS AS A QUANTITATIVE INDICATOR OF DISSOLVED CADMIUM: FINAL STUDY AND SYNTHESIS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. Fischer.
Marine Ecology Progress Series MESEDT, Vol. 48, p 163-174, 1988. 5 fig, 4 tab, 74 ref.

Descriptors: *Heavy metals, *Mussels, *Bioindicators, *Cadmium, *Pollutant identification, Bioaccumulation, Water pollution, Mytilus, Mathematical models, Tissue analysis.

Juvenile blue mussels Mytilus edulis were cultivated in flow-through aquaria to investigate the influence of dissolved cadmium on cadmium accumulation (in terms of the Cd/shell-wt index). Where the ratio (by weight) of dissolved Zn to Cd remains within the range 25:1 to 60:1, accumulation of Cd is not significantly influenced by dissolved Zn. Higher levels of concomitant Zn reduce the Cd/shell-wt index. A lower ratio of Zn to Cd may slightly increase Cd accumulation. The Cd/shell-wt index is proportional to ambient levels of dissolved Cd up to 100 micrograms/l. There were no significant effects on growth up to about 30 micrograms/l Cd. Results corresponded to earlier experimental work and to field surveillance data reported in the literature. A procedure is suggested by which the concentration of dissolved Cd in natural environments may be estimated from 'mussel watch' data (Cd body burden, shell weight) and salinity. Cd accumulation in the mussel is described by the integral of the Cd/shell-wt index with growth of shells by weight. A model of biochemical accumulation of metals requires laboratory and field transplant experiments to be designed such that considerable growth is allowed in a new environment in order to approximate a new balance of metal residues in organisms in relation to ambient levels. (Author's abstract)
W89-04424

USE OF MOLECULAR MARKERS FOR THE DETECTION OF MUNICIPAL SEWAGE SLUDGE AT SEA,
Massachusetts Univ. at Boston. Environmental Science Program.
R. P. Eganhouse, D. P. Olaguer, B. R. Gould, and C. S. Phinney.
Marine Environmental Research MERSDW, Vol. 25, No. 1, p 1-22, 1988. 3 fig, 5 tab, 37 ref.

Descriptors: *Pollutant identification, *Monitoring, *Municipal wastewater, *Sludge disposal, *Ocean dumping, Molecular markers, Chemical analysis, Waste disposal.

The concentrations of two classes of waste-specific molecular markers (the linear alkylbenzenes and the fecal sterols, coprostanol and epicoprostanol) were determined in six municipal sewage sludges. Total linear alkylbenzene concentrations ranged from 150 to 7300 micrograms/L, whereas coprostanol was present at levels approximately one order of magnitude higher (2.6 to 55 mg/L). Experiments were performed to establish the limits of detection and quantitation for these compounds in small volume (< about 2 liters) bulk water samples using high resolution gas chromatography and gas chromatography/mass spectrometry. In an effort to simulate the degree of dilution expected during the dumping of sludge in waters of the continental slope, water was mixed with the sludge samples in varying proportions (1000:1 to 100000 to 1), and the concentrations of the markers were determined. Comparison of the estimated limits of quantitation with marker concentrations measured in the diluted sludges showed that reliable quantitation of the linear alkylbenzenes was possible at dilutions less than 100000:1. Coprostanol and epicoprostanol, however, were measurable at a dilution of 100000:1. If background levels of the markers in blanks are reduced and larger volume water samples are processed at sea, it should be possible to extend present measurement capabilities to dilutions one to two orders of magnitude beyond those reported here. Molecular markers apparently can be used to monitor the short-term fate of sewage sludge in the deep ocean. (Author's abstract)
W89-04427

HYDROCARBONS AND HALOGENATED HYDROCARBONS IN COASTAL WATERS OF THE WESTERN MEDITERRANEAN (FRANCE),
Institut Francais de Recherche pour l'Exploitation de la Mer, Brest. Dept. Environnement Littoral.
For primary bibliographic entry see Field 5B.
W89-04432

ALIPHATIC HYDROCARBONS AND ISOMERS OF HEXACHLOROCYCLOHEXANE IN SPECIMENS OF WATER, ICE AND SNOW FROM THE GREENLAND SEA,
Arctic and Antarctic Scientific Research Inst., Leningrad (USSR).
For primary bibliographic entry see Field 5B.
W89-04435

VARIABILITY OF TOXIC TRACE CONTAMINANTS IN MUNICIPAL SEWAGE TREATMENT PLANTS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W89-04473

PERIPHYTIC DIATOMS AS INDICATORS OF LAKE ACIDITY,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 470-473, January 1988. 2 fig, 2 tab, 8 ref.

Descriptors: *Limnology, *Diatoms, *Acidity, *Lakes, *Acid rain effects, *Bioindicators, Rainfall, Oxygen demand, Chemical oxygen demand, Fragilaria, Conductivity, Correlation analysis, Indicators, Finland.

The relation between periphytic diatom communities and water chemistry in 135 small lakes in Finland was studied as part of a comprehensive research program on acidification. The diatom communities in lakes with low conductivity, chemical oxygen demand, color, and nutrient concentrations were found to differ clearly from those in lakes with the same pH but higher chemical oxygen demand, color, and nutrient concentrations. Because of the low species richness and scarcity of indifferent taxa, the calculated pH based on the diatom community is often too low in lakes with low conductivity and clear water without humic substances. The calculated pH can be too high as compared to the actual lake pH if the sample contains planktonic taxa such as Asterionella formosa, Fragilaria spp., Melosira ambigua, and M. italica which are classified as alkaliphilous, but which are often abundant in lakes with a pH down to 6. (Doria-PTT)
W89-04527

IMMUNOHISTOCHEMICAL LOCALIZATION OF CYTOCHROME P-450E IN LIVER, GILL AND HEART OF SCUP (STENOTOMUS CHRYSOPS) AND RAINBOW TROUT (SALMO GAIRDNERI),
West Virginia Univ. Medical Center, Morgantown. Dept. of Biochemistry.
M. R. Miller, D. E. Hinton, J. J. Blair, and J. J. Stegeman.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 37-39. 1 tab, 5 ref. PHS grants ES-4220 and CA-45131.

Descriptors: *Water pollution, *Water pollution effects, *Bioindicators, *Fish, *Trout, *Fluorescence, *Enzymes, *Immunology, Liver, Gills, Scup, Cytochrome P-450.

Monoclonal antibody directed against a major beta-naphthoflavone-induced form of teleost cytochrome P-450, P-450E was used to immunolocalize this enzyme in liver, gill and heart of scup and trout. Liver sections from both species showed P-450E in the cytoplasm of hepatocytes. No regional differences were observed which might indicate zonation of cytochrome P-450E within subpopulations of hepatocytes. Scup exocrine pancreatic cells were only weakly positive. In the gill of both fish, cytochrome P-450E was restricted to the endothelium (pillar cells) of secondary lamellae, where fluorescence appeared as a chain in longitudinal sections through lamellae and as star-shaped clusters in en face views. Sections of ventricular wall in both species revealed P-450E was restricted to endothelium at margins of muscle bands limiting heart ventricular lumen. Localization in the specific cells of these and other organs may be fundamentally important in understanding the role of cytochrome P-450E. (Author's abstract)
W89-04545

DEVELOPMENT OF IN VIVO GENOTOXICITY TESTS IN ESTUARINE FISH AND THEIR APPLICATION TO AQUATIC TOXICOLOGY,
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
J. C. Means, C. B. Daniels, and S. M. Baksi.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 327-331. 2 fig, 6 ref.

Descriptors: *Water pollution effects, *Bioindicators, *In vivo tests, *Toxicity, *Bioassays, *Water pollution, *Water pollution effects, *Fate of pollutants, *Fish, *Estuarine fisheries, *Embryonic growth stage, Assays, Bass, Minnows, Mutagenesis.

Genotoxicity assays were developed in embryonic stages of two species of fish, striped bass (Morone saxitilis) and sheepshead minnow (Cyprinodon variegatus), and in the adults of Fundulus heteroclitus

using metaphase chromosome aberrations as the endpoint. Dose-dependent responses were obtained with several chemical mutagens, including 9-aminoacidine, ethylmethane sulphonate, cyclophosphamide and N-methyl-N-nitro-N-nitroguanidine, added to estuarine water at doses spanning several orders of magnitude in compound concentration. Exposures ranged from one to four days; however, a two-day exposure time was found to be optimal in eggs and larvae. Tissues from the gills, kidney and intestinal tract of adult Fundulus were found to be responsive to mutagen exposure; however, the intestine gave the best responses. The results of these experiments suggest that these assays are sufficiently sensitive to be used in the field as well as in the laboratory. (Author's abstract)
W89-04563

5B. Sources Of Pollution

INVESTIGATING THE FATE OF DYES IN THE ENVIRONMENT,
Environmental Research Lab., Athens, GA.
G. L. Baughman, and T. A. Perenich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-184619. Price codes: A03 in paper copy, A01 in microfiche. Report No. EOA/600/D-88/050, March 1988. 7p, 2 tab.

Descriptors: *Path of pollutants, *Degradation, *Bioaccumulation, *Fate of pollutants, *Dyes, Mathematical models, Organic compounds, Aquatic environment, Calcium, Magnesium, Chemical reactions, Ion exchange, Sorption, Biological magnification.

The rationale and approach that underlie the use of mathematical models to forecast the environmental behavior of organic chemicals are examined. The general concepts are then used to show how knowledge of environmental and dye chemistry can be used to suggest pathways that are likely to be determinants of dye fate in aquatic systems. Reactions involving precipitation of Ca and Mg salts and ion exchange with sediments may be important for anionic and cationic dyes, respectively. The uncharged dyes are considered in regard to possible volatilization, sorption, and bioconcentration. Suitable kinetic and equilibrium constants are not currently available for quantitative prediction using mathematical models. (Author's abstract)
W89-03336

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 1.
Ecology and Environment, Inc., Buffalo, NY.
For primary bibliographic entry see Field 5C.
W89-03337

ESTIMATING RELEASES AND WASTE TREATMENT EFFICIENCIES FOR THE TOXIC CHEMICAL RELEASE INVENTORY FORM,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. Gerstle, and D. Perrin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-210380. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA 560/4-88-002, December 1987. Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986). 192p, 4 fig, 13 tab, 62 ref, 5 append. EPA Contract 68-02-4248.

Descriptors: *Regulations, *Monitoring, Water quality control, Water pollution sources, Chemical wastes, Bibliographies, Water quality, Air pollution, Secondary wastewater treatment, Standards, Water pollution prevention.

An overview is given of methods for estimating releases of chemicals into the environment for facilities subject to reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986. The methods include use of monitoring data, mass balance calculations, emission factors, and engineering judgement. Applicability of the various methods for particular process operations and environmental media are discussed, as well as example release calculations for each method. The document also discusses various waste treatment technologies and how to estimate treatment efficiency. The bibliography includes sources and availability and how to estimate treatment efficiency. Appendices include secondary wastewater treatment efficiencies for specific chemicals, fugitive emission factors for equipment leaks, storage tank emission equations, and some chemical/physical property data for the Section 313 listed chemicals. (Author's abstract)
W89-03338

COMPUTER CODES FOR THREE DIMENSIONAL MASS TRANSPORT WITH NON-LINEAR SORPTION,
British Geological Survey, Keyworth (England). Fluid Processes Research Group.
D. J. Noy.
Available from the National Technical Information Service, Springfield, VA 22161, as DE87-900964. Price codes: A03 in paper copy, A01 in microfiche. Report No. FLPU 85-4, March 1985. 16p, 2 fig, 8 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Mass transport, *Porous media, *Finite element analysis, *Computer programs, Sorption, Isotherms, Data interpretation.

This report describes the mathematical background and data input to finite element programs for three dimensional mass transport in a porous medium. The transport equations are developed and sorption processes are included in a general way so that non-linear equilibrium relations can be introduced. A three parameter isotherm is described as an example of the way that sorption data might be fitted and used in the programs. The programs themselves, which are designed to link with earlier groundwater flow programs, are then described and a guide given to the construction of the required input data sets. Concluding remarks indicate that the calculations require substantial computer resources and suggest that comprehensive preliminary analysis with lower dimensional codes would be important in the assessment of field data. (Lantz-PTT)
W89-03340

SPATIAL ESTIMATION OF ANNUAL WET ACID DEPOSITION USING SUPPLEMENTAL PRECIPITATION DATA,
Battelle Pacific Northwest Labs., Richland, WA.
S. J. Wampler, and A. R. Olsen.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003414. Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--14770, August 1987. 4p, 7 fig, 9 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Path of pollutants, *Acid rain, *Spatial distribution, *Chemistry of precipitation, *Air pollution effects, Prediction, Kriging, Precipitation, Monitoring, Air pollution.

Annual estimates of sulfate wet acid deposition are required to assess the impact of acid deposition on watersheds in the northeastern United States. Direct measurements of deposition to the watersheds are rarely available, so that it is necessary to interpolate spatially from nearby wet deposition monitoring sites. The purpose of the current study is to investigate two alternative approachs to the estimation of sulfate deposition. In the first approach, data from wet deposition monitoring sites from the Acid Deposition System (ADS) data base are used to estimate deposition. In the second approach, wet deposition monitoring sites from ADS are used to estimate concentration, but the more extensive network of precipitation monitoring sites available from the National Climatic Data Center is used to estimate precipitation amount to the watersheds and deposition is calculated as the product of the two estimates. In both cases kriging is used to do the spatial interpolation from monitoring sites to the watersheds. (Lantz-PTT)
W89-03356

QUALITY CONTROL EXPERIMENTS ON ORGANICS IN GROUND WATER AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY, LIVERMORE, CALIFORNIA,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5A.
W89-03358

INTERACTIVE SIMULATION OF THE FATE OF HAZARDOUS CHEMICALS DURING LAND TREATMENT OF OILY WASTES: RITZ USER'S GUIDE.
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5D.
W89-03362

INORGANIC AND ORGANIC MICRO POLLUTANTS IN INDUSTRIAL WASTE WATER (ANORGANISCHE EN ORGANISCHE MICROVERONTREININGINGEN IN INDUSTRIEEL AFVALWATER),
Ministerie van Verkeer en Waterstaat, The Hague (Netherlands). Afdeling Emmissie-Onderzoek.
W. Van Starkenburg, and A. B. Van Luin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-203468. Price codes: E04 in paper copy, A01 in microfiche. December 1985. 66p, 2 tab, 28 ref. English summary.

Descriptors: *Water pollution sources, *Pollutant identification, *Organic compounds, *Inorganic compounds, *Industrial wastewater, Chemical analysis, Heavy metals, Polychlorinated biphenyls, Phenols, Benzene, Tetrachlorine methane, Chlorine phenols.

In 1983 and 1984 research was conducted on the presence of a number of environment polluting substances in industrial wastewater. The study was set up as a result of an government order concerning the inventory of substances. This order stipulated that a number of environmental pollutants be measured in all wastewater streams. The Dutch Ministry of Transportation, Canals, and Rivers conducted a pre-inventory in order to check to which extent substances occur in wastewater from a large number of industries. Substances of the following groups were checked: heavy metals, drins (aldrin, dieldrin, etc.), PCBs, chlorinated phenols, benzene and chlorinated benzenes, trichloromethane and tetrachloromethane. The study has thrown light on the presence of these substances in the wastewater of a number of industries. A striking find was the frequent occurrence of chlorinated phenols in wastewater streams. (Author's abstract)
W89-03363

INSTALLATION RESTORATION PROGRAM. PHASE II - CONFIRMATION/QUANTIFICATION STAGE 2.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 5G.
W89-03372

NEW YORK HARBOR WATER QUALITY SURVEY, 1986.
New York City Dept. of Environmental Protection, Wards Island. Water Quality Section.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-130653. Price codes: A06 in paper copy, A01 in microfiche. 146p, 18 ref, 19 append.

Descriptors: *Water quality, *New York Harbor, *Surveys, Monitoring, Dissolved oxygen, Bacteria, Biological oxygen demand, Ammonia, Lead, Phosphorus, Cadmium, Copper, Mercury, Coliforms, Heavy metals, Zinc, Chromium, Nickel, Arsenic, Silver.

New York City's Dept. of Environmental Protection monitored 52 stations for ten weeks of the

1986 summer to provide the 77th year of the NY Harbor Water Quality Survey. Significant long-term improvements in DO, bacteria, BOD, ammonia, and lead were detected at most sites. A weak, but significant, harborwide increasing trend in total phosphorus, and scattered decreases in cadmium, copper, and mercury were also detected. Compliance with State water quality total coliform standards increased from 65% of the sites in 1985 to 85% in 1986, with the most dramatic improvements occurring in the Hudson River coinciding with the operation of the newly constructed North River Water Pollution Control Plant. All stations were in compliance with fecal coliform standards for the first time since the existence of such standards. Average DO met state standards at at 44 of 52 sites, although most sites contravened standards at least once. Compliance with standards improved for cadmium, chromium, mercury and zinc, and nickel to a lesser extent; copper and lead compliance exhibited little change. Copper, mercury and lead almost always exceeded standards by varying degrees, while cadmium, chromium, nickel, and zinc were normally closer to or below standards. Special sampling for arsenic and silver revealed low levels and no violations of standards. Significant rain events were associated with order-of-magnitude increases in coliforms and decreases up to 2 mg/L DO in several Harbor branches. Correlation and factor analyses revealed significant relationships between many conventional parameters, nutrients, metals, and sediment concentrations. Analyses omitted during the 1985 survey, but included in 1986, include plankton, volatile organics, chlorinated hydrocarbons, and organochlorine pesticides. (Author's abstract)
W89-03373

INSTALLATION RESTORATION PROGRAM. PHASE II - CONFIRMATION/QUANTIFICATION. STAGE 2 - BULK FUEL STORAGE AREA FUEL SPILL INVESTIGATION.
Weston (Roy F.), Inc., West Chester, PA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191022. Price codes: A10 in paper copy, A01 in microfiche. Final Report, October 1987. 187p, 12 fig, 12 tab, 8 append. USAF Contract F33615-84-D-4400.

Descriptors: *Cleanup operations, *Path of pollutants, *Oil spills, *Groundwater pollution, *McGuire Air Force Base, New Jersey, Fuel, Benzene, Toluene, Xylene, Oil, Hydrocarbons, Oil pollution.

McGuire Air Force Base (McGAFB) requested an inspection of a fuel spill site, and preparation of a presurvey report, for Air Force review and implementation. McGAFB has identified the source of the spilled fuel as the lines associated with a now inactive railroad off-loading facility. The leak was effectively stopped by permanently disconnecting these lines from the fuel system. As the primary parameters for evaluation of fuel migration and subsequent groundwater contamination, the following analytes were used: benzene, toluene, and xylenes, oil and grease. Based on the findings of the field investigation and the identification and preliminary evaluation of remedial alternatives, a three-step approach for a site restoration program was recommended to remediate the impact of the April 1984 fuel spills: implementation of an immediate response alternative to recover the floating hydrocarbons; identification of additional data needs involving the characterization of contaminant sources other than the fuel spill and further investigation of and definition of the plume of dissolved constituents at the eastern and southeastern portions of the Bulk Fuel Storage Area; and analysis of the long-term alternatives after immediate response measures have been completed. (Lantz-PTT)
W89-03376

INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 85, OHIO.
CH2M Southeast, Inc., Gainesville, FL.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191021. Price codes: A06 in paper copy, A01 in microfiche. February 1984. 139p, 13 fig, 12 tab, 33 ref, 11 append. USAF Contract F08637-80-G0010-5004.

Descriptors: *Water pollution control, *Water pollution prevention, *Path of pollutants, *Cleanup, Industrial wastes, Oil pollution, Solvents, Hazardous wastes, Water pollution sources, Surface waters, Groundwater pollution.

Department of Defense (DoD) policy, directed by Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazards to health and welfare that may have resulted from these past operations. A private firm was retained on June 24, 1983, to conduct the Air Force (AF) Plant 85 records search, to implement the DoD policy, a four-phase Installation Restoration Program. Phase I, the records search described here, is the identification of potential problems. The majority of industrial operations at AF Plant 85 have been in existence since 1941, and have been related to the final assembly, flight acceptance testing, and modification of jet aircraft. The major industrial operations include machining and forming, metal finishing and electroplating, painting and coating, small parts assembly, and aircraft and missile subassembly. These industrial operations generate varying quantities of waste oils, spent solvents, stripper, and cleaners. No evidence of environmental stress resulting from past disposal of hazardous wastes was observed at AF Plan 85. Indirect evidence (confirmed by visual observation of oil sheen) of contaminant migration exists at Site No. 5, Mason's Run Oil/Fuel Spill Site. The potential for surface-water migration of hazardous contaminants is relatively high at AF Plant 85 due to the relatively high annual precipitation, the low permeability of the site soils, the extensive paved areas, the resulting high stormwater runoff, the extensive stormwater drainage systems, and proximity to surface drainage. The potential for groundwater migration of hazardous contamination is moderately low, due primarily to the moderately low soil permeabilities, extensive paved areas, and moderately deep groundwater table. (Lantz-PTT)
W89-03377

SURVEY OF PESTICIDES USED IN SELECTED AREAS HAVING VULNERABLE GROUNDWATERS IN WASHINGTON STATE,
Environmental Protection Agency, Seattle, WA. Region X.
L. Sacha, D. Fleming, and H. Wysocki.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-199674. Price codes: A14 in paper copy, A01 in microfiche. Report No. EPA 910/9-87-169, July 1987. 305p, 8 append.

Descriptors: *Path of pollutants, *Pesticides, *Groundwater pollution, *Leaching, *Washington, Mapping, Groundwater, Agriculture, Geology, Irrigation.

Pesticide contamination of groundwater resulting from normal agricultural use has been documented in 23 states, including Washington. Several of the pesticide compounds which were found (for example, ethylene dibromide) pose unacceptable health risks at extremely low levels. To date, relatively few drinking water supplies have been tested for pesticides, though agencies suspect that pesticides will be found once the effort is made to look for them. Concerns are that pesticide contamination may be widespread and, depending on the pesticide, could cause serious problems. In April 1985, EPA Region 10's Pesticides Section began a pilot study to evaluate the potential in Washington's State for groundwater contamination from normal, commercial agricultural use of 'leachable' pesticides, and to gain a state overview of the problem. Study goals were to: (1) identify and map vulnerable groundwater areas in the state of Washington; (2) determine 'leachable pesticide use' in these vulnerable groundwater areas; and (3) identify and prioritize geographic areas of concern based on groundwater maps and pesticide use data. The mapping effort shows that extensive areas of Washington State may be susceptible to contamination from use of agricultural chemicals. However, caution is advised against interpreting maps strictly, as they are very general. Further refinement, particularly in the Puget Sound lowland region, might reduce the number and size of areas now designated as vulnerable. Groundwater vulnerability designations are based on geology and the practice of irrigation. (Lantz-PTT)
W89-03386

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 1.
Engineering-Science, Inc., Denver, CO.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 024. Price codes: N01 in paper copy, N01 in microfiche. Final Report for Air Force Plant PJKS Waterton, Colorado. for Period October 1985 to October 1986, October 1986. 907p, 30 fig, 20 tab, 39 ref, 13 append. USAF Contract F33615-84-D-4403.

Descriptors: *Colorado, *Path of pollutants, *Hazardous wastes, *Pollutant identification, Waterton, Industrial wastes, Heavy metals, Organic compounds, Phenols, Arsenic, Chromium, Selenium, Groundwater pollution, Radioactivity, Soil contamination, Path of pollutants, Surface water, Fate of pollutants, Chlorinated hydrocarbon.

A field investigation was conducted to confirm or deny the presence of hazardous wastes at eight sites at Air Force Plant PJKS near Waterton, Colorado. Activities at the plant that could have generated hazardous wastes include the development and testing of rocket engines. The field program included sampling of surface waters, soils, and sediments, and the installation and sampling of eight groundwater monitoring wells. Hazardous substances found at the eight sites included trechloroethene and other halocarbons, nitroso kimethylamine (a decomposition product of hydrazine), phenols, and trace amounts of heavy metals, including arsenic, hexavalent chromium, and selenium. Elevated levels of radiation were detected in groundwaters downgradient from a landfill known to contain a small amount (25 kg) of low-level radioactive magnesium-thorium alloy. Since natural uranium mineralization occurs within the area, the background level of radiation needs to be established before the significance of the measured radiation can be determined. Contamination of soils and sediments was determined to be of low significance because of the low levels of contamination and a lack of pathways for offsite migration. Contamination of surface and ground waters at some sites was judged to be moderately significant because the contaminants occurred at concentrations exceeding standards or guidelines to protect human health, and the potential for contaminant migration exists. Plans for future studies to determine the sources and extent of surface and ground water contamination were developed. (Author's abstract)
W89-03388

MIGRATION OF HAZARDOUS SUBSTANCES THROUGH SOIL. PART IV: DEVELOPMENT OF A SERIAL BATCH EXTRACTION METHOD AND APPLICATION TO THE ACCELERATED TESTING OF SEVEN INDUSTRIAL WASTES,
Army Dugway Proving Ground, UT. Chemical Lab. Div.
D. E. Long, M. J. Houle, D. C. Weatherhead, and G. K. Ricks.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 856. Price codes: A22 in paper copy, A01 in microfiche. Report No. DPG-FR-87-015, September 1987. 480p, 243 fig, 130 tab, 28 ref, 2 append. TECOM Project D-CO-523-ECP-012.

Descriptors: *Hazardous wastes, *Path of pollutants, *Leaching, Industrial wastes, Titanium, Zinc, Phosphorus, Oil industry, Soil contamination, Hydrogen ion concentration, Permeability coefficient.

The initial objective of this work was to measure the leachability of selected wastes and determine the attenuation characteristics of certain soils. But, because the distribution of an ion between a waste leachate and a soil depends upon the composition of the leachate and the prior history of the soil it was necessary to develop an experimental approach capable of simulating this dynamically-changing situation. Samples of wastes were collected from the following industries: zinc-carbon battery manufacturing, titanium dioxide pigment production, hydrofluoric acid manufacturing, white phosphorus production, oil re-refining, and two from zinc secondary-refining (cinders and scrubber-waste). Water extracts of these wastes were applied to Chalmers, Davidson, and Nicholson soils. The analysis of the resulting solutions for pH, conductivity, and concentrations of specified hazardous ions before and after contact with these clay soils allowed calculating distribution coefficients, penetration factors, the fraction of each ion retained on the soils, the amount flushed off from a soil by the passage of a later extract, the yield of an ion per unit weight of waste, and the amount of an ion penetrating and retained by a unit weight of soil. (Lantz-PTT)
W89-03389

PLUTONIUM, AM, CM AND SR IN DUCKS MAINTAINED ON RADIOACTIVE LEACHING PONDS IN SOUTHEASTERN IDAHO,
Department of Energy, Idaho Falls, ID. Radiological and Environmental Sciences Lab.
O. D. Markham, D. K. Halford, S. K. Rope, and G. B. Kuzo.
Health Physics HLTPAO, Vol. 55, No. 3, p 517-524, September 1988. 6 tab, 21 ref.

Descriptors: *Path of pollutants, *Radioactive wastes, *Radioisotopes, *Ducks, *Idaho, Ponds, Waterfowl, Tissue analysis, Animal tissues, Transuranic radioisotopes, Strontium radioisotopes, Human pathology, Littoral zone.

Concentrations of strontium 90, plutonium 238, plutonium 239 and 240, americium 241, curium 242, and curium 244 were determined in tissues of mallard ducks (Anas platyrhynchos) maintained for 43-145 d on radioactive leaching ponds. Highest concentrations of transuranics occurred in the gastrointestinal tract, followed closely by feathers. Approximately 75%, 18%, 6%, and 1% of the total transuranic activity in tissues analyzed were associated with the bone, feathers, GI tract, and liver, respectively. Concentrations in GI tracts were similar to concentrations in vegetation and insects in the littoral area of the ponds. The calculated total dose rate to the ducks from both Sr 90 and the transuranic nuclides was 0.69 mGy/d (69 mrad/d), of which 99% was to the bone. The potential effective dose equivalent to a human consuming the entire muscle and liver mass of one experimental duck with average nuclide concentrations was 0.46 microSv (0.046 mrem). Based upon average concentrations in experimental ducks and on surveys of wild waterfowl using this area, a conservative estimate of transuranic activity exported by wild ducks using the ponds during one year was 11.3 kBq (305 nCi). Similarly, the total amount of Sr 90 exported in muscle, bone, and lung of wild ducks in one year was 2.5 MBq (68.7 microCi). (Author's abstract)
W89-03390

VARIATION OF LONG-LIVED RADON DAUGHTERS IN PRECIPITATION,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
G. Rosner.
Science of the Total Environment STENDL, Vol. 69, p 179-190, 1988. 1 fig, 3 tab, 13 ref.

Descriptors: *Air pollution, *Fallout, *Precipitation, *Radon, *Radioisotopes, Chemistry of precipitation, Photometry, Radiochemical analysis, Rainfall, Lead radioisotopes, Polonium, Correlation analysis, Statistical analysis.

A determination is described which is based on low-energy photon spectrometry of lead 210 and subsequent radiochemical separation, followed by alpha spectrometry, of polonium 210. Observations were carried out over a five-year period. Concentration values were obtained by dividing the measured total deposition values by the amount of rainfall measured at the same site. The mean Pb-210 concentration in precipitation found in this work was comparable to reported mean values from other continental stations at similar northern latitude. The ratio of Po 210 to Pb 210 in deposition is reported in the literature to scatter widely; the present study confirmed this. The variation of Pb-210 deposition in time was closely related to the variation of precipitation with maxima during the summer months. No pattern seemed evident in the Po-210 deposition. A strong inverse correlation between Pb-210 and Po-210 concentrations and amount of rainfall (significance level for both, 99.9%) reflected the fact that with increasing amounts of rainfall the amount of radionuclides available for washout decreases. (Shidler-PTT)
W89-03399

REMOBILISATION OF ACTINIDES FROM INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY,
UKAEA Atomic Energy Research Establishment, Harwell (England). Environmental and Medical Sciences Div.
P. J. Burton, and L. P. Yarnold.
Science of the Total Environment STENDL, Vol. 69, p 239-260, 1988. 6 fig, 2 tab, 9 ref. CEC contract BI6-B-044-UK.

Descriptors: *Path of pollutants, *Radioactive wastes, *Fate of pollutants, *Estuaries, *Radioisotopes, *Intertidal areas, *Marine sediments, Solute transport, Suspended solids, Filtration, Radiochemical analysis, Plutonium, Americium, England, Tides, Meteorological data collection, Cores.

In order to determine actinide activities present in the solution and suspended particulate phases of seawater, mid-depth water samples were filtered as rapidly as possible after collection through preweighed Millipore filters (0.22-micron pore size). The filtered seawater and the sediment-containing filters were then analyzed separately for plutonium and americium. These procedures have enabled distribution coefficients (ratios of concentration of radionuclide in dry sediment to that in solution) for actinides to be calculated for samples collected as part of activity-balance studies conducted over complete tidal cycles in the Ravenglass estuary, Cumbria, England. A tidal-cycle experiment was carried out on 24 June 1985, three days after a spring tide. The quantities of water, sediment, and salt entering and leaving the estuary balanced very closely, especially when allowance was made for the input of water and sediment from the rivers over the 12-hr tidal period, which could be estimated from their mean flux at low water. The rate at which actinides left the estuary in the sediment phase peaked later than that for actinides in solution. The distribution coefficient for plutonium decreased as the flood tide entered the estuary; this was followed by a rise in the distribution coefficient over the period of the ebb. The americium distribution coefficient showed a slight rise on the flood, with a subsequent fall over the ebb. Currently, the Ravenglass estuary acts as a net source of actinide activity to the Irish Sea. In order to predict the long-term importance of this net loss to the sea, further meterological, tidal, and sediment-coring data will be needed. (Shidler-PTT)
W89-03401

DISTRIBUTION COEFFICIENTS OF RADIONUCLIDES BETWEEN SOILS AND GROUNDWATERS AND THEIR DEPENDENCE ON VARIOUS TEST PARAMETERS,
British Nuclear Fuels Ltd., Sellafield (England).
J. Bell, and T. H. Bates.
Science of the Total Environment STENDL, Vol. 69, p 297-317, 1988. 6 fig, 4 tab, 4 ref.

Descriptors: *Path of pollutants, *Radioactive wastes, *Soil contamination, *Groundwater pollution, *Radioisotopes, Hydrogen ion concentration, Temperature effects, Soil types, Clay, Sand, Plutonium radioisotopes, Uranium radioisotopes, Thorium radioisotopes, Equilibrium, Reproducibility, Strontium radioisotopes, Cesium radioisotopes.

This paper aims to place in perspective the relative importance of pH, temperature, groundwater composition, and contact time. Fission products, plutonium, uranium, and thorium were contacted with a variety of soil types. Results of studies of the influence of contact time using fixed parameters of soil:aqueous ratio = 1:10, temperature 15 C, and pH 6 indicated that equilibrium was seldom achieved even after 14 days' contact time. Another series of experiments was carried out with fixed parameters soil:aqueous ratio 1:10, pH 6, and contact time 7 days to test the effect of temperature in the range 10-25 C. In the case of strontium 85 no temperature dependence could be detected for any soil type. Plutonium 239 and thorium 228 showed positive temperature coefficients for the coarse soils and negative temperature coefficients for other soil types. It was noteworthy that clay had low retention properties for uranium 233. Further experiments were carried out with fixed parameters of 15 C, pH 6 and contact time 7 days to test the effect of soil:aqueous ratio in the range 1:100, 1:10, and 3:10. Taking into account that, at this contact time, equilibrium was far from attained and reproducibility was far from ideal, dependence on soil:aqueous ratio was not generally apparent. Finally, experiments were carried out with fixed parameters of 15 C, soil:aqueous ratio 1:10, contact time 7 days to test the effect of pH in the range 1-12. Cesium 137 exhibited low uptake at low pH when hydrogen ions were competing for cation-exchange sites and there was fairly constant retention in the pH range 4-8 consistent with ion-exchange process being dominant. Clay and sand generally represented extremes within which the other soil types lay; exceptions were Pu-239 when retention at pH 6 was a factor of 6 lower than on sand and U 233 which gave low but gradually increasing values of distribution ratio with increasing pH. (Shidler-PTT)
W89-03402

LEACHABILITY OF TECHNETIUM FROM CONCRETE,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung.
B. G. Brodda.
Science of the Total Environment STENDL, Vol. 69, p 319-345, 1988. 6 fig, 4 tab, 14 ref.

Descriptors: *Waste disposal, *Water pollution sources, *Concrete, *Leaching, *Radioactive wastes, *Technetium, Germany, Underground waste disposal, Path of pollutants, Cements, Portland cements, Aluminous cements, Blast-furnace cements, Concrete additives, Brines, Distilled water, Cesium radioisotopes, Chlorine radioisotopes, Solubility.

Technetium-bearing medium-level waste in the Federal Republic of Germany is supposed to be conditioned in concrete and stored in a salt-mine repository. An accidental ingress of water into the repository could lead to the formation of a brine solution which might corrode the barrier-system components and leach radionuclides from the concrete. The long half-life of Tc 99 might then permit its slow migration into the biosphere. The leachability of Tc was investigated with samples prepared from portland, aluminous, and blast-furnace cement with or without the additives bentonite and microsilica. A quinary brine solution and distilled water were applied as leachants. Cesium 137 and chlorine 36 were used for comparative measurements. With aluminous cement/bentonite 20% of the technetium had been leached into the brine after 60 days. Later, the slope of the leaching curve turned negative, due to the formation of new mineral phases with Tc as a constituent. Bentonite-free aluminous cement behaved somewhat better than the mixture. Portland cement with or without bentonite showed an overall medium leachability. The best results were obtained with blast-furnace cement. Leachability generally remained below 0.1%; bentonite was of no significance. Possibly, the Tc was rapidly fixed as a low-solubility species. Cs and Cl were leached by a factor of >100 faster than Tc from blast-furnace cement, supporting the assumption of a mineralogical fixation of Tc and a

diffusion-controlled migration of Cs and Cl ions. (Author's abstract)
W89-03403

INTERLABORATORY STUDY OF MERCURY IN FISH BASED ON THE ONTARIO FISH CONTAMINANT MONITORING PROGRAM,
Ontario Ministry of the Environment, Thunder Bay (Ontario).
For primary bibliographic entry see Field 5A.
W89-03404

FENVALERATE WASH-OFF FROM COTTON PLANTS BY RAINFALL,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. L. McDowell, G. H. Willis, L. M. Southwick, and S. Smith.
Pesticide Science PSSCBG, Vol. 21, No. 2, p 83-92, 1987. 3 fig, 5 tab, 12 ref.

Descriptors: *Water pollution sources, *Agricultural runoff, *Rainfall, *Cotton, *Pesticides, Mathematical models, Cropland, Fenvalerate, Thunderstorms, Simulated rainfall, Rainfall intensity, Runoff volume, Soil contamination.

Information on rainfall wash-off of foliar-applied pesticides is needed in developing mathematical models to predict the transport of pesticides to soil and in runoff from croplands. Fenvalerate ((RS)-alpha-cyano-3-phenoxybenzyl (RS)-2-(4-chlorophenyl)-3-methylbutyrate) is used extensively for cotton-insect control in the southern United States during July, August, and September, which are months of high-intensity thunderstorms. Fenvalerate was washed from mature cotton plants by the use of a multiple-intensity rainfall simulator. Fenvalerate concentration in wash-off from plants was independent of rain intensity. When 25 mm of rain was applied at 7, 13, 26, and 51 mm/h just 2 h after fenvalerate was applied at 0.224 kg/ha, 38 (plus or minus 10) % of the fenvalerate load on the plants was washed off. Fenvalerate concentrations in storm wash-off decreased with wash-off volume as hyperbolic functions. Rainfall amount affected the wash-off of fenvalerate from cotton to a greater extent than did rainfall intensity. This information greatly simplifies modeling the movement of fenvalerate from plant canopy to soil during natural storms. (Author's abstract)
W89-03426

MOVEMENT AND SPECIATION OF HEAVY METALS IN A SOIL AMENDED WITH SEWAGE SLUDGE CONTAINING LARGE AMOUNT OF CD AND NI (MIGRATION ET SPECIATION DES METAUX LOURDS DANS UN SOL SOUMIS A DES EPANDAGES DE BOUES DE STATION D'EPURATION A TRES FORTE CHARGE EN CD ET NI),
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
M. Legret, L. Divet, and C. Juste.
Water Research WATRAG, Vol. 22, No. 8, p 953-959, August 1988. 7 fig, 1 tab, 24 ref. English summary.

Descriptors: *Soil contamination, *Soil amendments, *Sludge utilization, *Path of pollutants, *Heavy metals, *Land disposal, *Sludge disposal, Cadmium, Lead, Nickel, Chromium, Leaching, Adsorption, Soil amendments, Path of pollutants, Fate of pollutants.

The migration and speciation of Cr, Pb, Ni and Cd were investigated in a sewage sludge-amended soil. The speciation of the metals was investigated by a selective extraction method making it possible to divide the samples into five fractions: exchangeable, oxidizable, acid-soluble, reducible and residual. Since metals are generally associated with the fine fraction, the investigation was carried out on 125 micron fraction samples. The concentration of metals measured in this way show a large increase in the metal contents of the surface horizon. It can be seen that there are large additions of Cd down to the 60-80 cm layer and of Ni down to the 40-60 cm layer in the case of massive applications of sludge. To determine the polluted samples with respect to the basic contents of the soil, the metal contents are given as a function of the Al contents. Investigation of the distribution of the metals in the various component phases of the soil using the method of selective extractions may help in understanding the phenomena of migration that have been observed. The metals associated with the exchangeable and oxidizable phases are, in fact, easily mobilized by ion exchange reactions and by the decomposition and transformation of organic matter. For the four metals studied, Cd migrates most readily in the soil, down to the 60-80 cm layer. Most of the Cd is in an exchangeable form in the soil, and this relative ease of exchange must be considered in the light of both the great mobility of this metal in soil horizons, and the availability of Cd with respect to plants. Ni is associated primarily with the oxidizable phase, and migrated as far as the 40-60 cm layer. Pb is associated with the acid-soluble and reducible phases, and moved little in the soil, as far as the 20-40 cm layer. The additions of Cr were smaller and this metal remains localized in the upper layer. Cr is found primarily in the residual phase. (Author's abstract)
W89-03431

ADSORPTION OF ZN(II) ONTO HYDROUS ALUMINOSILICATES IN THE PRESENCE OF EDTA,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W89-03437

STOCHASTIC MODELS FOR ESTIMATION OF EXTREME POLLUTION FROM URBAN RUNOFF.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
P. Harremoes.
Water Research WATRAG, Vol. 22, No. 8 p 1017-1026, August 1988. 10 fig, 4 tab, 18 ref.

Descriptors: *Urban runoff, *Path of pollutants, *Urban hydrology, *Storm runoff, *Stochastic process, *Model studies, Denmark, Rainfall-runoff relationships, Water pollution sources, Storm drains, Combined sewer overflows.

The calculation and evaluation of urban runoff has to be shaped according to the pollution problem in question. It is important to group such problems into two categories: acute and accumulative. The first calls for extreme statistics on an event basis, the latter on an annual basis. Deterministic modeling of pollutant transport during rain fails to eliminate very significant residual variability and stochastic elements have to be introduced. It is shown that accounting for the variability corresponds to an increase in pollutant transport for extreme events by a factor of 2-3. This ought to be of significance to the design of combined sewer overflows. (Author's abstract)
W89-03439

NEW METHOD FOR EXTRACTION OF C.I. REACTIVE RED 4 AND ITS DERIVATIVES FROM WATER,
Bayreuth Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W89-03442

INVESTIGATIONS ON THE CONCENTRATION OF RADIONUCLIDES IN SEWAGE SLUDGES OF RUHRVERBAND WASTEWATER TREATMENT PLANTS 1960 THROUGH TO 1986,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff, P. Koppe, and F. Dietz.
Water Research WATRAG, Vol. 22, No. 8, p 1059-1067, August 1988. 5 fig, 9 tab, 16 ref.

Descriptors: *Wastewater facilities, *Path of pollutants, *Radioactive wastes, *Fallout, *Nuclear powerplants, *Digested sludge, *Chernobyl, Federal Republic of Germany, Water pollution effects, Water pollution sources, Fish, Food chains, Pollutant identification.

The Ruhrverband operates a total of 118 municipal wastewater treatment works using predominantly biological treatment. Annually, some 1.9 million cu m of raw sludge is produced and mainly anaerobically digested. Supplementary to common analyses the digested sludges have been investigated for radioactivity since 1960. Thus, the additional loading resulting from fallout and wash out after the reactor accident on 26 April 1986 in Chernobyl could be precisely recorded. Prior to the description of the effects of the Chernobyl accident on river water, potable water and on wastewater sludges, a short background information on the occurrence of the accident and its consequences for the Federal Republic of Germany is given. The investigations performed document the considerable impact of radioactive fallout on the contamination of sewage sludges. While the residual beta-activity in all analyzed samples of digested sludges was below 900 Bq/kg dry solids in 1960, 3700 Bq/kg dry solids were exceeded in 42% of all samples in 1963 as a consequence of atmosphere nuclear test series between 1960 and 1962. After the stop of nuclear tests no residual beta-activities above 900 Bq/kg/dry solids were observed in 1966. Immediately after the Chernobyl accident the radioactivity in sewage sludges was far above these values, particularly because of the high fraction of short-life fission products, such as Iodine 131. With a few exceptions, the measured radioactivities in sludges are comparable to those determined in the surface layer of soil. Thus, in a first approximation the potential radioactive contamination of sludges can be estimated from the earlier available results of soil analyses. The radioactivity of sewage sludges in a period of 3 or 4 months after the Chernobyl accident decreased to only 10% of the initial value, leading to the conclusion that an application of sludges onto farmland is possible after sufficient storage and mixture. Such an application must be controlled and accompanied by analyses. (Author's abstract)
W89-03445

ROLE OF STREAM SUBSTRATES IN ALUMINIUM MOBILITY AND ACID NEUTRALIZATION,
Norsk Inst. for Vannforskning, Oslo.
A. Henriksen, B. M. Wathne, E. J. S. Rogeberg, S. A. Norton, and D. F. Brakke.
Water Research WATRAG, Vol. 22, No. 8, p 1069-1073, August 1988. 3 fig, 2 tab, 12 ref.

Descriptors: *Stream biota, *Neutralization, *Path of pollutants, *Acid rain effects, *Aluminum, *Acid streams, Substrates, Mosses, Macrophytes, Water pollution effects, Acidic water, Ion exchange, Cations.

Acidification experiments were conducted on two streams to determine the mobilization of Al and the size of the pool of exchangeable Al associated with streambed materials during acid episodes. The first experiment demonstrated a buffering capacity of the stream 20-fold higher than that associated with the water and resulted in releases of massive amounts of Al (to 2500 micrograms/l) at pH < 5. The source of buffering and the reservoir of Al was hypothesized to be dense growths of a liverwort. A second stream acidification and laboratory experiments confirm that mosses and liverworts in streams are important in the ion exchange of base cations and Al during acid episodes. Short-term neutralization was dominated by release of base cations by ion-exchange and long-term neutralization of H(+) was dominated by release of Al. (Author's abstract)
W89-03446

USE OF METAGAME ANALYSIS IN ACID RAIN CONFLICT RESOLUTION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and N. Okada.
Journal of Environmental Management JEVMAW, Vol. 27, No. 2, p 153-162, September 1988. 5 tab, 6 ref.

Descriptors: *Planning, *Acid rain, *Theoretical analysis, *Political aspects, *Water pollution

sources, *Air pollution, *Canada, *Water quality management, Decision making, Water pollution prevention, Fate of pollutants, Models, Stability analysis.

A game-theoretical technique is applied to the acid rain management conflict in Canada. The interactions between Canadian political groups and industries are examined, using potential outcomes and alternative preference functions. The importance of determining the preference ordering for the conflict participants is demonstrated, as the outcome resolution is shown to vary greatly with different preference orderings. (Author's abstract)
W89-03458

LOAD CONTROL REGULATION OF WATER POLLUTION: AN ANALYSIS USING GAME THEORY,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Mathematics.
D. M. Kilgour, N. Okada, and A. Nishikori.
Journal of Environmental Management JEVMAW, Vol. 27, No. 2, p 179-194, September 1988. 4 fig, 20 ref.

Descriptors: *Pollution load, *Water pollution sources, *Water pollution control, *Theoretical analysis, *Management planning, *Chemical oxygen demand, Regulations, Cost allocation, Economic aspects, Models, Waste management, Mathematical studies.

The load control system for regulating chemical oxygen demand (COD) in water bodies is described and compared with conventional systems based on concentration controls. Load control regulation is extremely valuable for certain closed water systems, but it inevitably implies questions of fairness in cost-sharing among regulated municipalities. This situation is a natural application for the normative fairness principles of cooperative game theory. The cost-sharing game is formulated in general, and solved in some illustrative cases. (Author's abstract)
W89-03459

PESTICIDE RESIDUES IN MILK AND FISH SAMPLES COLLECTED FROM UPPER EGYPT,
Central Agricultural Pesticides Lab., Cairo (Egypt).
S. M. Dogheim, M. M. Almaz, S. N. Kostandi, and M. E. Hegazy.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 71, No. 5, p 872-874, September-October 1988. 5 tab, 5 ref.

Descriptors: *Pesticide residues, *Fish, *Egypt, *Polychlorinated biphenyls, *Milk, Chlorinated hydrocarbons, DDT, Aldrin, Dieldrin, Heptachlor, Lindane, Catfish, Fate of pollutants, Gas chromatography.

In Egypt, buffalo milk is much preferred by consumers over cow's milk, while small catfish and bolti fish are common in the diet of farmers. Samples of buffalo milk, catfish, and bolti fish collected from Beni-Suef Governorate (Upper Egypt) were analyzed for organochlorines and polychlorinated biphenyls. The results obtained by gas chromatography and confirmed by thin-layer chromatographic techniques revealed high amounts of organochlorines in milk; residues were lower but occurred more frequently in fish samples. Pesticide contaminants found most often were hexachlorocyclohexane isomers including lindane, DDT complex, aldrin and dieldrin, heptachlor and heptachlor epoxide, hexachlorobenzene, and oxychlordane. Polychlorinated biphenyls were not detected in any of the analyzed samples. (Author's abstract)
W89-03470

GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC CONFIRMATION OF IDENTITY OF COPROSTANOL IN MERCENARIA MERCENARIA (BIVALVIA) TAKEN FROM SEWAGE-POLLUTED WATER,
Food and Drug Administration, Washington, DC. Center for Food Safety and Applied Nutrition.
For primary bibliographic entry see Field 5A.
W89-03471

RESIDUE LEVEL DETERMINATION OF THE AQUATIC HERBICIDE FLURIDONE AND A POTENTIAL PHOTOPRODUCT (N-METHYLFORMAMIDE) IN WATER,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
For primary bibliographic entry see Field 5A.
W89-03472

TRACE METALS IN THE EASTERN PART OF THE NORTH SEA. II: FLOWS OF CD, CU, HG, PB AND ZN THROUGH THE COASTAL AREA,
Vrije Univ., Brussels (Belgium). Lab. voor Analytische Chemie.
W. Baeyens, G. Gillain, F. Ronday, and F. Dehairs.
Oceanologica Acta OCACD9, Vol. 10, No. 3, p 301-309, July 1987. 7 fig, 4 tab, 10 ref.

Descriptors: *Heavy metals, *North Sea, *Path of pollutants, *Coastal waters, Cadmium, Copper, Mercury, Lead, Zinc, Belgium, Salinity, Dissolved solids.

The residual flow lines off the Belgian coast are more or less parallel to the coast except in the area where the northeasterly flowing watermass coming from the English Channel encounters the southwesterly-oriented Scheldt outflow. The result is a residual hydrodynamical front with, at the northern side, a less saline estuarine watermass, and at the southern side a more saline marine watermass. From the steady-state salinity pattern, diffusion coefficients perpendicular to the residual flow were deduced; they ranged from 21 to 108 sq m/sec. The steady-state profiles of dissolved metals versus salinity indicate a dilution effect in the coastal-estuarine watermass and an almost constant concentration in the marine watermass. Offshore fluxes of Cd, Cu, Hg, Pb and Zn based on diffusive and mixing processes are calculated. They can explain the concentration increases in the coastal flow tube (315 cu km/yr), but are insignificant beyond that flow tube. The ratios of the Scheldt output to the offshore flux vary from 38 to 85%, depending on the kind of metal. The ratio of the Scheldt output to the metal flow parallel to the coast is smaller than 1%. The steady-state concentration profiles of particulate metals versus salinity are fairly constant in the coastal-estuarine and marine watermasses, but decrease very abruptly from the first to the second watermass. Assuming a conservative behavior of the particulate metals, offshore fluxes and the resulting concentration increases in the coastal flow tube were deduced. These calculated concentration increases agree fairly well with the observed values. The contribution of the Scheldt estuary to the flows parallel to the coast ranges from 1.6 to 3.3%. (Author's abstract)
W89-03476

EFFECTS OF SEA CAGE SALMON FARMING ON SEDIMENT NITRIFICATION AND DISSIMILATORY NITRATE REDUCTIONS,
Cawthron Inst., Nelson (New Zealand).
For primary bibliographic entry see Field 6G.
W89-03477

FATE OF C14-CARBOFURAN IN A RICE-FISH MODEL ECOSYSTEM,
Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt).
S. M. A. D. Zayed, A. E. El-Arab, and I. Y. Mostafa.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 23, No. 4, p 401-407, August 1988. 2 tab, 11 ref.

Descriptors: *Pesticide residues, *Rice, *Models, *Fate of pollutants, *Fish, *Insecticides, Bioaccumulation, Ecosystems, Carbamate pesticides, Soil contamination, Carbon radioisotope.

The distribution of C14-carbofuran residues among the constituents of a model rice-fish ecosystem was studied over a period of 90 days. Carbofuran was readily absorbed from the root system and distributed to all parts of the rice plant of the different constituents of the model ecosystem, rice plants contained the highest concentration of C14-residues. The results obtained indicate that carbofuran does not accumulate in fish to an appreciable extent. In water, the parent compound decreased appreciably with time and contributed about 10% of the total C14-residues after 30 days. Analysis of residues in fish, plant and soil showed, apart from the parent compound, the presence of several metabolites (60% of residues). Among the degradation products, 3-hydroxycarbofuran and carbofuran phenol were identified as major metabolites. (Author's abstract)
W89-03486

REDUCING IMPACTS OF NONPOINT SOURCE POLLUTION FROM AGRICULTURE: A REVIEW,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 7, p 645-667, October 1988. 3 tab, 34 ref.

Descriptors: *Nonpoint pollution sources, *Agricultural runoff, *Farm wastes, *Path of pollutants, *Water pollution prevention, *Fertilizers, Pesticides, Erosion control, Feedlot wastes, Agricultural chemicals, Manure, Water quality management, Water pollution sources, Reviews.

Nonpoint source pollution from agriculture affects both surface water and groundwater quality. Water quality degradation is caused by erosion and sediment, animal wastes, fertilizer and pesticides. Best management practices that control runoff and erosion will reduce particulate nitrogen and phosphorus loads but may increase nitrate losses in subsurface drainage. Only applying enough nutrients to meet crop needs will reduce nitrogen and phosphorus losses. Nonpoint source pollution from animal agriculture may result from animals grazing, open animal confinement feedlots, and manure disposal areas. In most cases pollution from feedlots is greater than from manure application sites or grazing areas. Pesticides with solubilities of greater than 10 ppm are lost mainly in the water phase of runoff. Runoff and erosion control best management practices will reduce pesticide losses in surface runoff. (Author's abstract)
W89-03488

EFFECTS OF SIMULATED ACID RAIN ON EXTRACTABLE AND LEACHED CATIONS OF A LEXINGTON SILT LOAM,
Louisiana Agricultural Experiment Station, Baton Rouge.
B. C. Liljeholm, and S. E. Feagley.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 7, p 669-688, October 1988. 5 fig, 4 tab, 18 ref.

Descriptors: *Soil contamination, *Path of pollutants, *Acid rain, *Leaching, *Cations, Potassium, Calcium, Magnesium, Iron, Manganese, Leachates, Clay minerals, Loam, Hydrogen ion concentration, Water pollution effects.

Soil cores were collected to a depth of 15.2 cm from a Lexington silt loam. Simulated precipitation at pH values of 3.7, 4.7, and 5.7 were applied to the soil cores in increments of 500 ml/day until volumes approximated 10, 20, 40, and 80 years (14, 28, 56, and 112 L, respectively) of effective rainfall in Louisiana. Extractable cations including K, Ca, Mg, Fe, and Mn were measured from 2.5 cm sections of the soil cores after treatment. The extractable cations were affected by the treatments to a depth of 5.1 to 7.6 cm. The soil surface was depleted of measureable exchangeable Ca and Mg by the leaching solution of pH 3.7 treatment at the 40 yr volume of application. The leaching solutions of pH 4.7 and 5.7 depleted the soil of exchangeable Ca and Mg at the 80 yr volume. These ions were moved below the zone of increased acidity. The exchangeable K at the soil surface was not re-

moved in significant amounts, but the subsurface K was increased to amounts that were half the control surface K concentrations by the 80 yr volume of application. This increase was probably due to released K fixed by clay minerals present such as smectite, mica, and hydrated vermiculite. Extractable Mn was reduced to 0.035 mg/kg by the pH 3.7 treatment at the 80 yr volume of application. Extractable Fe was not significantly affected by the pH of the leaching solutions at any volume studied. (Author's abstract)
W89-03489

CHEMISTRY OF A TYPICAL DUTCH RESERVOIR, THE TJEUKEMEER, IN RELATION TO ITS WATER MANAGEMENT BETWEEN 1970 AND 1986,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W89-03497

HYDROCARBONS AND PHENOLS IN DISCHARGE WATER FROM OFFSHORE OPERATIONS: FATE OF THE HYDROCARBONS IN THE RECIPIENT,
Bergen Univ. (Norway). Dept. of Chemistry.
O. Grahl-Nielsen.
Sarsia SARIA3, Vol. 72, No. 3/4, p 375-382, 1987. 6 fig, 5 tab, 14 ref.

Descriptors: *Bioindicators, *Chemical analysis, *Chemical analysis, *Oil pollution, *Fate of pollutants, *Monitoring, Hydrocarbons, Phenols, Aromatic compounds, Offshore platforms, Volatile hydrocarbons.

Problems in the determination of petroleum hydrocarbons in water, sediment, and biota are illustrated. By dyeing of the discharge water from a land-based oil refinery and an offshore production platform the uneven distribution in the recipient was demonstrated. Volatile benzenes and nonvolatile hydrocarbons, as well as phenols, were determined in the discharge water from the platform. The fate of the hydrocarbons in the recipient, particularly with respect to evaporation, was studied. Aromatic hydrocarbons, as pollution markers, were determined in the tissue of blue mussels from the jackets of the platforms on the field. The applicability of blue mussels in the monitoring of the pollution is discussed and compared with the use of cod and saithe for the same purpose. The variation between replicate samples in tissue levels of petroleum hydrocarbons was larger for saithe and cod than for the blue mussels, which suggests that fish are less suited for monitoring of the pollution level than blue mussels. (Sand-PTT)
W89-03512

ASSESSMENT OF BENTHIC PHOSPHORUS REGENERATION IN AN ESTUARINE ECOSYSTEM MODEL,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-03531

HEAVY METALS IN MARINE NEMERTEANS,
Liverpool Polytechnic (England). Dept. of Biology.
E. G. McEvoy.
Hydrobiologia HYDRB8, Vol. 156, p 135-143, January 4, 1988. 6 fig, 6 tab, 26 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Marine animals, *Nemerteans, *Bioindicators, Littoral environment, Lead, Cadmium, Zinc, Seasonal variation, Animal tissues, Adsorption, Absorption, Radioisotopes.

The main objective of this project was to establish the possible use of marine nemerteans as indicators of heavy-metal pollution in the littoral environment. Accumulation of lead, cadmium, and zinc by two species of nemerteans, Lineus ruber (Heteronemertea) and Amphiporus lactifloreus (Hoplonemertea) varied both seasonally and interspecifically. L. ruber consistently exhibited higher levels of zinc, while lead and cadmium content varied with sampling site. Seasonal patterns were similar for total body burden of lead in the two species with maxima in the late summer and minima in early winter. Seasonal patterns for cadmium and zinc were dissimilar for the two species. The proportion of surface mucus-adsorbed metals could be quantified by immersion of experimental animals in iminodiacetic acid coupled to Epoxy-activated Sepharose 6B (40-100 micron diameter). In this way surface-associated adsorbed metals could be differentiated from absorbed metals present in the body tissues. The use of the Sepharose technique as a method for the non-invasive removal of surface adsorbed metals will be employed in conjunction with energy-dispersive X-ray micro-analysis for future investigations on 'metal mapping' for both internalized and epidermally-associated elements. Due to the property of nemertean mucopolysaccharide secretions to bind ionic metal species, it may also be possible to exploit this capability for the detection of low-level radionuclides present in the marine environment. (Shidler-PTT)
W89-03539

COMPARISON OF SULFUR CONCENTRATIONS WITHIN LAKE SEDIMENT PROFILES,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
M. J. Mitchell, S. C. Schindler, J. S. Owen, and S. A. Norton.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 219-229, January 22, 1988. 6 fig, 2 tab, 43 ref. Electric Power Research Institute RP-2174-10.

Descriptors: *Paleolimnology, *Acid rain, *Sulfates, *Water pollution sources, *Sulfur, *Lake sediments, Diagenesis, Enrichment, Cores, Dating, Adirondack Mountains, New England, Great Lakes States, Florida, Fate of pollutants.

Sediment cores from lakes in four regions (Adirondack Mountains, northern New England, northern Great Lakes states, and northern Florida) were analyzed for total sulfur concentration. In all regions S concentrations in pre-1900 (1820-1900) sediment were similar and pre-1900 net sediment accumulation rates of S were not significantly different. S enrichment was greatest in Adirondack lake sediments, which had total post-1900 S accumulation of 1.1 to 7.4 times pre-1900 S accumulation; post-1900 net sediment accumulation rates of S were significantly greater than the other regions. Sediment from Maine and Vermont generally had lower S concentration than Adirondack sediments. S-enrichment factors in these lakes ranged from 1.2 to 2.1. There was a positive correlation between contemporary limnetic sulfate concentration and post-1900 net sediment-accumulation rates for Adirondack and northern New England study lakes. Sediment from the northern Great Lakes states region had similar S concentration and distribution with depth to northern New England sediment. In two northern Florida lakes sediment showed little variation in S concentration with depth, but Lake Mary and L. Barco had higher S in deeper layers (30-55 cm). These different patterns of S distribution among lakes were attributed to differences in limnetic sulfate concentration, organic and inorganic sedimentation, and S diagenesis. (Author's abstract)
W89-03552

EXPERIMENTAL STUDIES ON SOME FACTORS INFLUENCING PHOSPHORUS SOLUBILIZATION IN CONNEXION WITH THE DRAWDOWN OF A RESERVOIR,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2H.
W89-03557

SEASONAL CHANGES IN SEDIMENT AND WATER CHEMISTRY OF A SUBTROPICAL SHALLOW EUTROPHIC LAKE,
Central Florida Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 2H.
W89-03558

NITROGEN DYNAMICS IN A EUTROPHIC LAKE SEDIMENT,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 2H.
W89-03560

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART I. THE DENITRIFICATION PROCESS,
Parma Univ. (Italy). Ist. di Ecologia.
For primary bibliographic entry see Field 2I.
W89-03561

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART II. FRACTIONATION AND BIO-AVAILABILITY OF ORGANIC NITROGEN COMPOUNDS,
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
For primary bibliographic entry see Field 2I.
W89-03562

MEASURING CONTAMINANT TRANSPORT RATES BETWEEN WATER AND SEDIMENTS USING LIMNOCORRALS,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
L. Chant, and R. J. Cornett.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 237-245, March 22, 1988. 6 fig, 1 tab, 16 ref.

Descriptors: *Path of pollutants, *Sediment-water interfaces, *Mesocosms, *Trace elements, *Radioisotopes, Radioactive tracers, Dystrophic lakes, Americium, Cobalt, Radium, Mercury, Bottom sediments, Suspended sediments, Sorption, Reproducibility, Stable isotopes.

Radiotracers injected as soluble salts into approximately 1.2 cu m limnocorrals in a shallow dystrophic lake were transported rapidly (2 to 12%/d) from the water to the bottom sediments. Removal rates of most contaminants declined after about 14 days. Tracers were removed from the water much more rapidly than stable-element analogs present naturally. After 3 wk americium, cobalt, radium, mercury, tin, and iron activities on the enclosure walls were greater than 15% of the activity in the water. However, activity on the walls was a small fraction (<6%) of the total amount of tracer injected. Particle fluxes inside the corrals were lower and much less variable than those measured outside. This difference appears to result from greater resuspension of bottom sediments in the lake than in the enclosures. Both particle-bound and soluble tracers were measured in cores of bottom sediments. Tracer sorption onto particles, diffusion into the bottom sediments, and uptake on the plastic enclosure walls were rapid and reversible. Tracer kinetics were very reproducible in replicate enclosures, providing a simple, experimental system in which limnological conditions can be manipulated. Loss rates and distributions of stable isotopes and radioisotopes can be used to develop and test a general model of element transport applicable to both short and long term analyses. (Author's abstract)
W89-03565

INCORPORATION OF 35SO4(2-) INTO SEDIMENTS OF THREE NEW YORK LAKES,
State Univ. of New York Coll. at Oswego. Research Center.
D. H. Landers, and M. J. Mitchell.
Hydrobiologia HYDRB8, Vol. 160, No. 1, p 85-95, March 8, 1988. 2 fig, 5 tab, 51 ref.

Descriptors: *Acid rain, *Acidification, *Path of pollutants, *Fate of pollutants, *Lake sediments, *Sulfates, *Radiochemical analysis, *New York, Sulfur, Sulfides, Oxygen, Acidic water, Alkalinity, Respiration, Cores, Incubation, Pyrite.

Intact sediment cores were obtained from three New York lakes. Radioactive sulfur 35 (as sulfate ion) was added to the overlying water and cores

were incubated without atmospheric exchange for one week at near-lake-bottom temperatures. Headspace flux of oxygen as an index of sediment respiration rates varied among lakes and seasonally within lakes. Acidic South Lake had the lowest respiration rate at all seasons and also the smallest net incorporation of the radioactive sulfate ion. Summer net isotope transformation into ester sulfate and non-hydriodic-acid(HI)-reducible S (pyrite and carbon-bonded S) constituents was 88.6%, 89.4%, and 59% of total sediment isotope for Oneida, Deer, and South Lakes. Seasonal variation of net isotope incorporation was observed in each lake as were differences in radioactive sulfate partitioning into major S pools. Of the S-constituents analyzed, hydrochloric-acid-digestible S (volatile sulfides) was the smallest pool, while ester sulfate and non-HI-reducible S together accounted for greater than 50% of S-isotope transformation in all lakes. In addition, ester sulfate is the major product of dissolved sulfate transformation and its formulation results in less alkalinity generation than the formation of not-HI-reducible S constituents. Thus ester sulfate transformation processes must be considered in calculating alkalinity generation by lake sediments. (Author's abstract)
W89-03574

PREPRINTS OF PAPERS PRESENTED AT THE 196TH ACS NATIONAL MEETING.
Los Angeles, CA, September 25-30, 1988. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. 471 p.

Descriptors: *Water pollution sources, *Path of pollutants, *Greenhouse effect, *Fate of pollutants, *Symposium, *Chemical analysis, *Water analysis, *Water pollution effects, *Pollutant identification, Computer models, Statistical methods, Chemical reactions.

Papers presented at the 196th Annual National Meeting of the American Chemical Society are discussed. Topics include: (1) data analysis and trace constituents and toxic compounds, (2) photochemical oxidants and their precursors, (3) ionizing radiation in drinking water, (4) environmental chemistry of dyes, (5) Biogeochemistry of carbon dioxide and the greenhouse effect, and (6) biological markers of environmental contaminants. Examples of data analysis procedures appropriate for investigations of trace constituents and toxic compounds are presented. One symposium was organized into two sessions, including 'spatial data analysis' and 'trend analysis and other statistical comparisons'. The first paper in each session provides an overview of the topic and the papers which follow further demonstrate recent developments in the interpretation of environmental chemistry data. Another symposium focused on new developments in the field of atmospheric photochemical oxidants. The relationship of radon in a drinking water to indoor air and with geological formations and the overall population risk estimates for radionuclides in drinking water are discussed. Some of the most recent developments in the areas relevant to the fate of dyes are presented. Changes that might be expected if the concentration of carbon dioxide and other trace gases continues to increase in the atmosphere are described. Research on the development, application and validation of biological markers in environmental species as indicators of exposure to toxic chemicals (or as predictors of the adverse consequences of that exposure) is discussed. (See W89-03596 thru W89-03656) (Miller-PTT)
W89-03595

STATISTICAL METHODS FOR A REGIONAL GROUND-WATER QUALITY APPRAISAL IN DIFFERENT LAND-USE AREAS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-03596

TRACE ORGANIC COMPOUNDS IN GROUND WATER IN SOUTH-CENTRAL KANSAS AS INFERRED FROM GAS CHROMATOGRAPHY WITH FLAME-IONIZATION DETECTION,
Kansas State Geological Survey, Lawrence.
J. O. Helgesen, and E. M. Thurman.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 9-12. 3 fig, 3 ref.

Descriptors: *Nonpoint pollution sources, *Water analysis, *Gas chromatography, *Kansas, *Groundwater pollution, *Water pollution, Trace levels, Organic compounds, Oil industry, Rangeland.

A 13,000 square kilometer area in south-central Kansas was studied to compare organic groundwater quality between relatively undeveloped rangeland areas and petroleum production areas. Potential nonpoint-source contamination in petroleum production areas is posed by hydrocarbons that may move downward in association with brines disposed of in leaky surface ponds. Gas chromatography analyses of random groundwater samples from beneath both types of areas indicated concentrations sufficiently small so as to prevent identification of specific organic compounds. Results obtained from gas chromatography with a flame-ionization detector were evaluated using nonparametric statistical analyses. The presence and relative concentrations of these trace compounds indicate no definite differences between the rangeland and petroleum production areas. The applied data analysis procedures provide examples of using chromatogram-peak frequency and height to characterize organic-compound occurrence. (See also W89-03595) (Author's abstract)
W89-03597

INTELLIGENT DATA ANALYZER: HERBICIDE TRANSPORT IN THE CEDAR RIVER, IOWA,
Kansas State Geological Survey, Lawrence.
E. M. Thurman, P. J. Squillace, K. M. Strzepek, and L. Garcia.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 13-15.

Descriptors: *Data analysis, *Path of pollutants, *Herbicides, *Cedar River, *Iowa, *Graphical analysis, *Computers, *Computer models, Water pollution, Artificial intelligence, Rivers, Water quality, Model studies, Statistical analysis, Seasonal variation, Agricultural runoff, Alachlor, Atrazine.

The U. S. Geological Survey, in cooperation with the University of Colorado, has developed an intelligent data analyzer prototype that uses artificial intelligence technology to assist water quality specialists in the analysis of large chemical and hydrographic data bases. The prototype was used to analyze the transport of herbicides in the Cedar River, which drains a large basin (about 17,000 sq km) in eastern Iowa. The program uses physical modeling to estimate the mass flux of herbicides from surface and ground water and displays the data in graphical form. The interactive color graphics allow the user to do rapid real-time sensitivity analysis on the mass flux of herbicides at six different sampling sites. Furthermore, simple statistical procedures can be used to analyze the data, including: (1) regression analysis, (2) bar charts, and (3) histograms in a series of stacked windows. The program calls upon the expertise and experience of the user as well as the graphical color display of data to interpret mass flux of herbicides in surface water. Application of the prototype to the Cedar River in Iowa indicates variation in herbicide transport related to seasonal runoff and drainage area. A trazine and alachlor were the major herbicides present. (See also W89-03595) (Miller-PTT)
W89-03598

DATA CHARACTERISTICS: GROUNDWATER MONITORING'S 'CATCH 22',
IBM Corp., Hopewell Junction, NY. General Technology Div.
For primary bibliographic entry see Field 7C.
W89-03600

PREDICTION OF RAINWATER ACIDITY USING TRACE ELEMENT CONCENTRATIONS,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. J. Vong, and R. E. Peterson.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 30-33. 13 ref. USDOE contract DE-AC06-76RLO-1830.

Descriptors: *Water pollution sources, *Statistical models, *Acid rain, Least squares method, Emission spectroscopy, Neutron activation analysis, Precipitation, Chemistry of precipitation, Trace elements, Estimating, Copper smelting, Sulfates, Hydrogen ion concentration.

A multivariate regression model, partial least squares, was applied to trace element data to predict rainwater acidity near a large copper smelter located in Tacoma, Washington. From > 50 chemical measurements which were obtained via instrumental neutron activation analysis, ion chromatography, pH, and inductively coupled plasma emission spectroscopy, the data were reduced to a smaller set of precise and appropriate chemical variables. The data analysis included determining the detection limits from blanks, calculating total concentrations from soluble and insoluble instrumental neutron activation analysis, evaluating experimental precision based on ten co-located samplers and calculating upwind-downwind differences for six storms. Partial least squares extracted three intrepretable factors which correctly predicted the smelter's contribution to SO4 and pH in rain collected immediately downwind. Partial least squares was able to estimate a smelter contribution to acidity based on the smelter's trace metal fingerprint for two other downwind regions where other methods do not provide an estimate. (See also W89-03595) (Author's abstract)
W89-03603

FACTORS GOVERNING THE CONCENTRATION OF HYDROGEN PEROXIDE IN STORM INFLOW AIR,
Brookhaven National Lab., Upton, NY.
L. I. Kleinman, and A. C. D. Leslie.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 99-102. 2 fig, 8 ref. USDOE contract DE-AC02-7600016.

Descriptors: *Water pollution sources, *Air pollution, *Acid rain, *Hydrogen peroxide, *Chemical reactions, Storms, Precipitation, Chemistry of precipitation, Troposphere.

Aqueous phase reaction of S02 with H202 is a major source of sulfate and acidity in precipitation in industrialized regions. Under many conditions, the total amount of S02 oxidized to H2S04 can be limited by the amount of H202 present in the atmosphere. Gas phase H2O2 has been measured at mid-tropospheric altitudes during June 1987, near Columbus, Ohio. Data from five flights at pressure levels above 750 mb (approximately 2600 m) indicate that H2O2 is an increasing function of dew point. Photochemical calculations show that, for many conditions of interest in moderately polluted regions, the formation rate of H2O2 is proportional to the rate at which free radicals are produced. Radical production, in turn, is often dominated by photolysis of O3 yielding O(1D), followed by a reaction of O(1D) with H20 yielding 2OH. The observed dependence of H2O2 on dew point can be qualitatively explained by the above reaction sequence. (See also W89-03595) (Miller-PTT)
W89-03604

PHOTOLYSIS OF FE(III)-HYDROXY COMPLEXES AS A SOURCE OF HYDROXYL RADICALS IN ATMOSPHERIC WATERS,
Duke Univ., Durham, NC. School of Forestry and

Environmental Studies.
B. C. Faust, and J. Hoigne.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 114-115. 1 fig.

Descriptors: *Water pollution sources, *Atmospheric water, *Iron, *Photochemical reactions, *Acid rain, Chemical reactions, Chemistry of precipitation, Precipitation, Photolysis.

The measurement of the rate of Fe(OH)(+2) photolysis was investigated under conditions which closely approximate the chemical conditions of acidified clouds, rain, and fog. Experiments were performed, using sunlight or monochromatic light, with air-saturated solutions containing 0.00001 M soluble monomeric Fe(III) at pH 3 to 4. A critical review of 40 years of literature provided quantum yields for this reaction, which together with experimental measurements of quantum yields were used in a photochemical model to predict rate of Fe(OH)(+2) photolysis in sunlight. Experimental and model results indicate that the sunlight photolysis rate of Fe(OH)(+2) is significantly faster than previous conservative estimates. Additional results are presented on model calculations of the sunlight photolysis of Fe(III) dimers -- Fe2(OH2)(+4) -- as a source of OH radicals and on experimental investigations of the photolysis of Fe(III)-oxalate complexes as a source of Fe(II). A general discussion is given on photochemical reactions of oxy-radicals produced in the re-oxidation of Fe(II) to Fe(III). (See also W89-03595) (Miller-PTT)
W89-03605

RADIOACTIVITY IN SPRING WATER AND SURFACE WATER OF SOUTHERN NEVADA,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2F.
W89-03608

TRANSFER OF RADON FROM POTABLE WATER INTO HOUSE AIR,
Maine Univ., Orono. Dept. of Physics.
For primary bibliographic entry see Field 2K.
W89-03611

REVIEW OF EXPERIMENTAL ADDITIONS OF RHODAMINE WT DYE INTO REACTIVE AQUATIC ENVIRONMENTS,
Geological Survey, Menlo Park, CA.
K. E. Bencala, and G. W. Zellweger.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 175-176. 13 ref.

Descriptors: *Tracers, *Dye releases, *Dyes, *Acid mine drainage, *Fate of pollutants, Water pollution, Aquatic environment, Rhodamine WT dye, Acidic water, Solubility.

Several studies, that recently appeared in the literature, of the fate of rhodamine WT in reactive environments that were acidic or that presented significant opportunity for dye sorption onto solids are reviewed. Because the dye is routinely used in hydrologic studies, its intentional introduction into aquatic environments has provided many opportunities for observation in field situations. In certain environments, rhodamine WT has demonstrated reactivity. In an acidic and metal-rich stream, the stability of rhodamine WT was time dependent and varied with location along the stream. The effects of acidic waters on dyes include lowered dye solubility and enhanced photochemical decay. In acidic water, the dye has shown a high affinity for amorphous Fe(OH)3 surfaces, which are themselves commonly found in acid mine drainage. (See also W89-03595) (Miller-PTT)
W89-03612

DEGRADATION OF DISPERSE BLUE 79 IN ANAEROBIC SEDIMENT-WATER SYSTEMS,
Environmental Research Lab., Athens, GA.
E. J. Weber.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 177-180. 3 fig, 1 tab, 8 ref.

Descriptors: *Dyes, *Degradation, *Fate of pollutants, *Water pollution source, *Dye industry wastes, *Anaerobic conditions, Disperse Blue 79 dye, Aromatic compounds, Amines, Nitrogen compounds, Sediment-water interfaces.

The degradation of Disperse Blue 79 (a disperse dye produced in large quantities in the United States) and 2-bromo-4,6-dinitroaniline (an important intermediate in the preparation of Disperse Blue 79) were studied in anaerobic sediment-water systems. Both compounds were readily reduced in these systems; half-lives were on the order of minutes. For Disperse Blue 79, five degradation products were detected, three of which were identified as 1,2-diamino-4-nitro-6-bromobenzene and two azo compounds resulting from reduction of the nitro groups. These results indicate that the azo linkage and the nitro groups of Disperse Blue 79 are susceptible to reduction. 1,2-Diamino-4-nitro-6-bromobenzene was detected in both the aqueous and sediment phases, whereas the azo compounds could be detected only in the sediment phase. Reduction of 2-bromo-4,6-dinitroaniline in a sediment-water system yielded only 1,2-diamino-4-nitro-6-bromobenzene. These studies suggest that disperse azo dyes may undergo reduction in bottom sediments in the environment, resulting in the subsequent release of potentially hazardous aromatic amines into the water column. (See also W89-03595) (Author's abstract)
W89-03613

BIOLOGICAL WASTEWATER TREATMENT OF AZO DYES,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W89-03614

DYES IN THE ENVIRONMENT: DYEING WASTES IN LANDFILL,
Georgia Inst. of Tech., Atlanta. School of Textile Engineering.
W. C. Tincher, and D. W. Dickson.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 188-190. 1 tab, 4 fig, 3 ref.

Descriptors: *Textile mill wastes, *Dye industry wastes, *Landfills, *Fate of pollutants, *Wastewater treatment, *Sludge disposal, Biological wastewater treatment, Degradation, Chromatography.

Experiments have been conducted to determine the fate of dyes that enter landfill via sludge from biological treatment plants receiving textile dyeing wastewater. A simulated landfill facility was constructed and filled with sludges from three treatment plants receiving more than 75% textile dyeing wastewater. Effluent and landfill interior samples were collected and analyzed by high performance liquid chromatography for 24 dyes used in large volumes in textile dyeing. Detectability limits were 1 to 10 parts-per-billion for most dyes included in the study. No dyes were present in the effluents or column interior samples at levels greater than the detectability limits. Effluent and interior samples were also analyzed for priority pollutants and possible dye degradation products by gas chromatography-mass spectrometry. No dye degradation products were found in the dye column effluent samples. Subsequent studies on dyes exposed to sludges suggest that the dyes are strongly adsorbed and tenaciously held by wastewater treatment plant sludges. (See also W89-03595) (Author's abstract)
W89-03617

SOLUBILITY OF DISPERSE DYES -- ENVIRONMENTAL IMPLICATIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5A.
W89-03619

LIVER CYTOCHROME P-450E LEVELS ASSOCIATED WITH CHLOROBIPHENYL RESIDUES IN STARRY FLOUNDER FROM SAN FRANCISCO BAY,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-03628

SLOW DESORPTION OF HALOGENATED ALIPHATIC COMPOUNDS IN SOILS,
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
J. J. Pignatello.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 373-375. 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Pesticides, *Sorption, *Organic compounds, *Adsorption, *Soil contamination, *Fate of pollutants, *Desorption, Soils, Sediments, Equilibrium, Halogenated pesticides, Fumigants.

Several halogenated aliphatic compounds, including fumigant pesticides and industrial chemicals, were examined for their slow desorbing behavior in soils. Based on equilibrium distribution coefficients, these compounds can be regarded to have weak to moderate sorption tendencies. Two desorption schemes were used: (1) consecutive aqueous extraction, and (2) desorption with continuous removal of aqueous-phase chemical. A relatively immobile sorbed fraction was obtained for all compounds, ranging up to several percent of initial. Increasing adsorption time resulted in increasing amounts but decreasing lability of this fraction. Significant amounts were liberated on pulverization of the soil, suggesting the presence of soil structures which occlude the chemical. (See also W89-03595) (Author's abstract)
W89-03645

VAPOR DISTRIBUTION OF TRICHLOROETHANE AND RELATED COMPOUNDS IN SOIL GAS ABOVE CONTAMINATED GROUND WATER AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ.
J. A. Smith.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 376-377. 3 ref.

Descriptors: *Chlorinated hydrocarbons, *Toxic wastes, *Path of pollutants, *Soil gases, *Groundwater pollution, *New Jersey, *Soil contamination, Fate of pollutants, Vapor distribution, Trichloroethane, Vadose water, Soil moisture.

The distribution of trichloroethane, cis-1,2-dichloroethane and tetrachloroethane vapors in soil gas above a contaminant plume at Picatinny Arsenal in Morris County, New Jersey has been studied. Vadose-zone gas samples were collected from two or three depths at each of six locations above the main axis of the groundwater solute plume. Trichloroethane vapor concentrations decreased with horizontal distance downgradient from the contaminant source and vertical distance above the water table. The concentration of trichloroethane in all vapor samples collected from depths within 0.75 m of land surface was less than the analytical detection limit of 40 ng/l. The highest trichloroethane concentration (7270 ng/l) was measured in gas samples collected approximately 0.3 m above the water table near the source of contamination. Cis-1,2-dichloroethane and tetrachloroethane also were detected in select gas samples at maximum concentrations of 133 and 134 ng/l, respectively. Concentrations of trichloroethane, cis-1,2-dichloroethane and tetrachloroethane in the vadose-zone

soil gas show significant correlations with the concentrations of the same compounds in the underlying groundwater. Measurement of the moisture content of soil samples collected from the vadose zone, in conjunction with laboratory-generated water-vapor isotherms for the same soil samples, indicates that the distribution of trichloroethane between vapor and soil can be predicted by a conventional water-soil isotherm and the Henry's Law constant of the compound. (See also W89-03595) (Author's abstract)
W89-03646

MONITORING THE DEGRADATION PRODUCTS OF PETROLEUM HYDROCARBONS IN SOIL GAS AND GROUNDWATER,
D. L. Marrin.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 378-381. 2 fig, 6 ref.

Descriptors: *Toxic wastes, *Fate of pollutants, *Petroleum products, *Degradation, *Hydrocarbons, *Soil gases, *Groundwater pollution, *Carbon dioxide, Soil contamination, Path of pollutants, Monitoring.

Detecting the presence, and monitoring the migration, of petroleum hydrocarbons in subsurface environments has become a major focus at sites where soil or groundwater is contaminated by refined petroleum products. Many of these hydrocarbons are not readily monitored by the collection and analysis of groundwater or soil-gas samples due to their low solubilities or vapor pressures. Petroleum hydrocarbons are often oxidized under aerobic or mildly reducing conditions to produce carbon dioxide gas as an end product. Mapping carbon dioxide concentrations in shallow soil gas can sometimes provide an approximation of subsurface plumes even though the hydrocarbon contaminants are absent from soil gas. This technique is particularly useful for detecting hydrocarbons which are either readily degraded (chemically or biologically) or are semi-volatile. In addition, the presence of intermediate breakdown products in downgradient monitoring wells has been used to predict potential migration pathways for petroleum hydrocarbons since these oxidized intermediates are considerably more mobile than their parent compounds. While confirmatory soil and/or groundwater sampling is always required, analyzing for breakdown products in shallow soil gas and off-site groundwater samples has been used to estimate the subsurface migration of hydrocarbon contaminants. (See also W89-03595) (Author's abstract)
W89-03647

OZONE BY-PRODUCTS IN DRINKING WATER PRODUCED UNDER FULL SCALE TREATMENT CONDITIONS,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 5F.
W89-03648

PARTS-PER-TRILLION LEVELS OF POLYCHLORINATED DIBENZOFURANS FOUND IN THE EDIBLE PORTION OF SELECTED FISH,
Food and Drug Administration, Washington, DC. Contaminants Chemistry Div.
A. M. Gardner, and K. D. White.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 388-390. 1 tab, 9 ref.

Descriptors: *Toxic wastes, *Path of pollutants, *Polychlorinated, Dibenzofurans, *Fish, Water pollution effects, *Path of pollutants, *Gas chromatography, *Mass spectrometry, Chlorinated hydrocarbons, Pollutant identification.

Fillets of thirty-five fish were examined for polychlorinated dibenzofurans. The fish were from 8 sites contaminated with industrial chemicals or with known or suspected levels of polychlorinated biphenyls. Polychlorinated dibenzofurans were extracted and cleaned up by column chromatography on a series of modified silica gels, carbon and aluminum adsorbents. Selected ion mass spectrometry with capillary gas chromatography was used for quantification. Predominant polychlorinated dibenzofurans found were: (1) 2,3,7,8-tetra-chlorinated dibenzofuran which occurred in 13 fish at levels up to 95 ppt, and (2) 2,3,4,7,8-penta-chlorinated dibenzofuran which occurred in 14 fish at levels up to 114 ppt. Other tri- through hepta-chlorinated dibenzofurans were found with less frequency. These were tentatively identified as 2,4,6-substituted polychlorinated dibenzofurans. Polychlorinated dibenzofurans were not found in 15 fish. Whereas the presence of polycyclic aromatic hydrocarbons in seven fish had been judged an indicator of polychlorinated dibenzofuran contamination in fish, the absence of polychlorinated dibenzofurans in seven fish with up to 45 ppm polycyclic aromatic hydrocarbon suggested that this correlation may not always be valid. (See also W89-03595) (Author's abstract)
W89-03649

ASSESSMENT OF HEALTH RISK FROM LITHOGENIC MERCURY,
Portland State Univ., OR.
For primary bibliographic entry see Field 5C.
W89-03650

PHOTOCHEMICAL REACTIONS OF ANTHROPOGENIC CHEMICALS IN SEAWATER,
California Univ., Davis. Dept. of Environmental Toxicology.
A. P. Toole, and D. G. Crosby.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 414-415. 6 ref.

Descriptors: *Toxic wastes, *Path of pollutants, *Degradation, *Seawater, *Chemical reactions, *Pollutant identification, *Photochemical reactions, Photolysis, Water pollution.

Several probable seawater pollutants were selected as probes for studying photochemical reactions in seawater, including 2-nitrotoluene, 4-nitrotoluene, styrene, 4,5-dichloroguaiacol, 4,5,6-trichloroguaiacol, and tetrachloroguaiacol. Solutions of each probe in buffered distilled water, synthetic seawater and natural seawater were irradiated in a temperature-controlled photoreactor. Photolysis rates, based on first order or psuedo-first order kinetics were calculated and photoproducts identified. No degradation was observed in any dark controls and rates for all probes were the same in filter-sterilized and raw natural seawater. All six probes had photolysis rates in natural seawater that were different from those in distilled water. Synthetic seawater appeared to be a very good model for natural seawater in the case of the chlorinated guaiacols, but less so for 2-nitrotoluene, 4-nitrotoluene and styrene. 2-Nitrotoluene and styrene had higher rates in natural seawater than in distilled water, while the other four probes had lower rates. Sodium chloride accelerated the photolysis of 2-nitrotoluene by catalyzing an intra-molecular rearrangement; however, it decreased the apparent photolysis rate of all three chlorinated guaiacols, possibly by participating in a photonucleophilic substitution reaction with the chlorines on the ring. Magnesium and calcium ions had an inhibitory effect on the photolysis of both 2- and 4-nitrotoluene. Natural seawater or photosensitizers or photooxidants mediated the photochemical transformation of styrene to styrene oxide. (See also W89-03595) (Author's abstract)
W89-03652

CAN CHLOROPHENOLS - DECONTAMINATED THROUGH BINDING TO HUMIC ACID - BE RELEASED,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W89-03654

ANAEROBIC TRANSFORMATIONS OF COMPLEX ORGANIC COMPOUNDS IN SUBSURFACE SOILS,
Mankato State Univ., MN. Dept. of Biological Sciences.
B. L. Proctor.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 427-430. 8 fig.

Descriptors: *Toxic wastes, *Fate of pollutants, *Organic compounds, *Soil contamination, *Groundwater pollution, Sorption, Anaerobic conditions.

Results from a 2 year study of the adsorption/desorption and biotic/abiotic transformation of (1) phenothiazine, (2) 2,2',4,4' tetrachlorobiphenyl, (3) 1-chloronaphthalene, (4) 2-fluoromethyl phenothiazine, and (5) 2-chloro-5 trifluoromethyl benzophenone in anaerobic subsurface soil microcosms are discussed. Phenothiazine, 2-fluoromethyl phenothiazine and 2-chloro-5 trifluoromethyl benzophenone were transformed in the anaerobic environment. The major transformation products were identified by electron impact gas chromatography/mass spectrometry. After seven months in the anaerobic subsurface soil microcosms, 1-chloronaphthalene and 2,2',4,4' tetrachlorobiphenyl have not been changed. (See also W89-03595) (Author's abstract)
W89-03655

INFLUENCE OF DRY DEPOSITED SULFATE AND NITRATE ON PRECIPITATION CHEMISTRY IN THE LOS ANGELES AIR BASIN,
ERT, Inc., Camarillo, CA.
J. R. Young, J. F. Collins, A. A. Huang, M. D. Zeldin, and E. C. Ellis.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 431-437. 1 fig, 3 tab, 6 ref.

Descriptors: *California, *Water pollution sources, *Sulfates, *Nitrates, *Ammonium, *Los Angeles, *Air-water interfaces, *Statistical methods, *Acid rain, Pollutant identification, Chemistry of precipitation, Hydrogen ion concentration, Calcium.

Precipitation samples, collected on an event basis in Southern California since late 1979 by the Southern California Edison Company, were analyzed for pH, conductivity, major cations and anions and trace metals. The number of active sites in the sampling network has varied from 16 to 24. Quality control methods such as ionic balance and statistical means of identifying outliers were used to screen data before inclusion into a validated precipitation chemistry data base. An observed linear relationship between log concentration and log volume for individual precipitation events was used to remove the influence of event volume on precipitation chemistry. Principal component analysis of the volume-adjusted data set identified independent sources contributing to the chemical composition of precipitation in Southern California. These sources include: (1) a neutral soil dust/sea salt component with dry-deposited sulfate and nitrate, (2) an acidic anthropogenic component comprised of sulfate, nitrate, and ammonium, and (3) components representing independent behavior of acidity, calcium, and ammonium. (See also W89-03595) (Author's abstract)
W89-03656

FLOOD CONTROL OF URBAN RUNOFF IN THE EAST AREA OF OSAKA PREFECTURE (NEYA RIVER BASIN),
Osaka Prefecture Sewerage Div. (Japan).
For primary bibliographic entry see Field 4A.
W89-03665

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT.
For primary bibliographic entry see Field 5G.
W89-03679

SYSTEM APPROACH TO ANALYSIS OF WATER QUALITY DUE TO TRANSPORT MECHANISMS IN THE WATER ENVIRONMENT,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 6A.
W89-03690

WATER QUALITY MODELING BY A LINEAR SYSTEM APPROACH,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03691

ANALYSIS OF HISTORICAL SURFACE WATER ACIDIFICATION IN SOUTHERN NORWAY USING A REGIONALIZED CONCEPTUAL MODEL (MAGIC),
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6A.
W89-03692

SURFACE WATER ACIDIFICATION: THE BIRKENES DATA REVISITED,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck, D. Drummond, F. M. Kleissen, S. Langan, and H. S. Wheater.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 133-150, 10 fig, 11 ref.

Descriptors: *System analysis, *Acidification, *Acid rain, *Birkenes, *Model studies, *Time series analysis, Rainfall, Streams, Algorithms, Mathematical models, Precipitation, Hydrogen, Calcium, Magnesium, Aluminum, Sulfates, Catchment areas, Flow, Estimating equations, Acid streams, Surface water, Norway.

Previous experimental studies of the Birkenes catchment in southern Norway have been a seminal contribution to the investigation of surface water acidification phenomena. Despite considerable progress in the development and evaluation of mathematical models by reference to this catchment, relatively little work has been done on the systematic identification of these models. In this paper, time-series field data from the autumn of 1974 are reexamined using, among other methods, recursive estimation algorithms (the extended Kalman filter, and an instrumental variable estimator). The data comprise daily observations of precipitation, and the concentrations of H(+), Ca(2+), Mg(2+), Al(3+), and SO4(2-) ions in the stream draining the catchment. These show the unequivocal response of the catchment to acidic precipitation events, although it is by no means easy to disentangle from the observations the precise nature of the relationships between causes and effects. Preliminary results suggest that the behavior of the Birkenes catchment is usually dominated by physical water flow characteristics and that chemical interactions are of greatest significance and interest during the first major precipitation event following a long, dry summer period. (See also W89-03679) (Author's abstract)
W89-03693

CALIBRATION AND COUPLING OF CONCEPTUAL RAINFALL-RUNOFF/CHEMICAL FLUX MODELS FOR LONG-TERM SIMULATION OF CATCHMENT RESPONSE TO ACIDIC DEPOSITION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2A.
W89-03694

MODELLING DISTRIBUTIONS OF AQUATIC CHEMISTRY IN REGIONS IMPACTED BY ACID DEPOSITION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W89-03695

DEVELOPMENT OF A LAKE ACIDIFICATION MODEL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 173-181, 4 fig, 12 ref.

Descriptors: *Systems analysis, *Model studies, *Lakes, *Acidification, *Acid rain, Rainfall, Carbon dioxide, Carbonates, Bicarbonates, Equilibrium, Physical properties, Chemical properties, Biological properties, Seasonal variation, Hydrogen ion concentration, Alkalinity, Epilimnion, Hypolimnion, Interfaces, Air-water interfaces, Runoff, Model testing, Photosynthesis, Respiration, Nitrification, Oxidation, Denitrification, Sulfur, Sulfates.

A lake acidification model has been developed to quantify a cause-effect relationship between acid inputs and lake responses. The model incorporates the carbon dioxide-bicarbonate-carbonate equilibria with major physical, chemical, and biological processes, which affect the seasonal lake pH and alkalinity levels, in a two-layer (epilimnion and hypolimnion) time-variable fashion. Processes incorporated into the model include carbon dioxide exchange at the air-water interface, vertical diffusion in the water column, and processes contributing to internal sinks and sources of alkalinity and carbon dioxide acidity (e.g., photosynthesis, respiration, nitrification, sulfide oxidation, denitrification, and sulfate reduction). Alkalinity and carbon dioxide acidity input from atmospheric precipitation on the lake surface as well as from the watershed runoff are also incorporated as loadings. The model has been applied to the Bickford Reservoir in Massachusetts, Panther and Woods Lakes in New York, and Lake Anna in Virginia with encouraging results. (See also W89-03679) (Author's abstract)
W89-03696

MODELLING STREAM ACIDIFICATION IN UPLAND WALES,
Institute of Hydrology, Wallingford (England).
P. G. Whitehead, R. Neale, and P. Paricos.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 183-194, 5 fig, 3 tab, 13 ref.

Descriptors: *Systems analyis, *Acid rain, *Wales, *Model studies, *Acidification, Prediction, Streams, Watersheds, Forest watersheds, Catchment areas, History, Forests, Coniferous forests.

Historical reconstructions and predictions of streamwater acidification are presented for a moorland and a forested catchment in the Welsh Uplands at Llyn Brianne. The model MAGIC (Model of Acidification of Groundwater In Catchments) is used to illustrate that atmospheric deposition and conifer afforestation can increase stream acidity. The historical trends determined by the model illustrate that long-term acidification has been present since the turn of the century and will continue unless deposition levels are reduced significantly. (See also W89-03679) (Author's abstract)
W89-03697

KINETIC AND EQUILIBRIUM FORMULATIONS IN MODELLING OF HYDROPHOBIC ORGANIC CHEMICALS IN SURFACE AND GROUND WATERS,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. J. Witkowski, and P. R. Jaffe.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 333-338, 3 fig, 8 ref.

Descriptors: *Systems analysis, *Path of pollutants, *Model studies, *Kinetics, *Equilibrium, *Organic compounds, *Sorption, *Fate of pollutants, Sediments, Monte Carlo method, Aroclors, Polychlorinated biphenyls, Surface water, Groundwater.

Soil/sediment uptake and release processes are important in properly modeling the behavior and fate of anthropogenic organic compounds in natural water systems. Sorption/desorption processes can be represented by either equilibrium- or kinetic-based formulations. Monte Carlo-type simulations, using a Latin hypercube sampling scheme, are used to determine which sorption formulation is appropriate for a number of different environmental systems. The results show that for certain combinations of system parameters the equilibrium-based formulations are accurate. For other combinations, a kinetic formulation is necessary to properly account for the dynamics of the sediment-contaminant interactions. (See also W89-03679) (Author's abstract)
W89-03712

LOGIC DYNAMIC SIMULATION FOR WATER QUALITY MANAGEMENT,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 6A.
W89-03720

NARRAGANSETT BAY: ISSUES, RESOURCES, STATUS AND MANAGEMENT.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 2L.
W89-03723

POLLUTION INPUTS,
E. Hoffman.
IN: Narragansett Bay: Issues, Resources, Status and Management. Proceedings of a Seminar held January 28, 1985, Washington, DC. NOAA Estuary-of-the-Month Seminar Series, No. 1, August 1987. p 31-70, 8 fig, 10 tab, 54 ref.

Descriptors: *Rhode Island, *Water pollution sources, *Narragansett Bay, *Urban runoff, *Wastewater disposal, Industrial wastewater, Sewers, Industrial wastes, Industrial wastewater, Oil pollution, Oil spills.

Preliminary findings of National Oceanic and Atmospheric Administration (NOAA) research on the sources of pollutants in Narragansett Bay are summarized. Each source (urban runoff, dry weather combined sewer overflow discharges, sewage treatment plants, direct industrial discharge, waste crankcase oil dumping, and oil spills) and the methods used to assess its magnitude are discussed. The data is combined to evaluate the relative importance of the various sources. Finally, the possible applications of these data to water quality management issues are examined, and future research requirements are explored. (See also W89-03723) (Lantz-PTT)
W89-03725

CIRCULATION DYNAMICS,
For primary bibliographic entry see Field 2L.
W89-03726

PHYSICAL AND CHEMICAL METHODS FOR THE CHARACTERIZATION OF HAZARDOUS WASTES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5A.
W89-03731

COLLABORATIVE STUDY OF THE TOXICITY CHARACTERISTICS LEACHING PROCEDURE (TCLP),
S-Cubed, La Jolla, CA.
W. B. Blackburn, I. Show, D. R. Taylor, and P. J. Marsden.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-165691. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/4-87/ 045. December 1987. 78p, 7 fig, 45 tab, 5 ref. EPA Contract 68-03-1958.

Descriptors: *Model studies, *Simulation, *Path of pollutants, *Leaching, *Hazardous wastes, *Toxicity Characteristic Leaching Procedure, Leachates,

Organic compounds, Volatile organic compounds, Metals, Pesticides.

The U.S. EPA has developed a new procedure, the Toxicity Characteristic Leaching Procedure (TCLP), to simulate more effectively the leaching of hazardous materials from waste disposed in an unsecured landfill. The procedure involves: (1) an 18-hour extraction of a sample with sodium acetate solution and (2) the subsequent analysis of the leachate for metals, pesticides, semivolatile organics, and volatile organic compounds. To validate the method for all but the volatile organic analytes, 3 waste samples at different pH levels were sent to 23 different volunteer government and commercial laboratories for extraction and analysis. For validation of the TCLP procedure involving determination of volatile organic compounds, two fortified waste samples were distributed to each participating laboratory. The results and statistical analysis of this collaborative test are presented and discussed. The results indicate that the TCLP can be applied consistently by a diverse group of organizations for the analyses considered in this study. (Author's abstract)
W89-03736

ABIOTIC TRANSFORMATIONS OF TOXIC ORGANIC CHEMICALS IN THE LIQUID PHASE AND SEDIMENTS,
Environmental Research Lab., Athens, GA.
N. L. Wolfe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-218391. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/120, June 1988. 23p, 5 fig, 1 tab, 37 ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Groundwater pollution, Porous media, Permeability coefficient, Hydrogen ion concentration, Organic carbon, Oxygen, Hydrolysis, Soil contamination, Path of pollutants, Aquifers, Sorption.

Analyses of selected groundwater databases provide insight into the abiotic reaction conditions that occur in subsurface ecosystems. With this information it is possible to impose boundaries on the activity of selected chemical species in porous media and narrow the ranges of reactivities to be studied in quantifying abiotic transformation processes. The groundwater parameters that are addressed here are Eh, pH, oxygen levels, and organic carbon content. These data suggest that neutral or pH independent hydrolysis would be the more important process for many organic compounds in groundwater systems than would alkaline of acid hydrolysis pathways. Also the data suggest that, for abiotic redox transformation reactions of organic compounds, reductive processes would be more important. Based on the knowledge of the kinetics of abiotic hydrolysis of selected organic compounds in soil and aquifer samples, it appears that sorption affects the observed hydrolysis rate constant depending on the hydrolytic pathway. For example, neutral hydrolysis occurs in the sorbed phase with the same disappearance rate constant as in the aqueous phase. Thus, hydrolysis rate constants measured in water in the laboratory can be used to model hydrolysis in most natural aquifer systems. (Author's abstract)
W89-03739

ACCIDENTALLY SPILLED GAS-OIL IN A SHORELINE SEDIMENT ON SPITSBERGEN: NATURAL FATE AND ENHANCEMENTS OF BIODEGRADATION,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
P. Sveum.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-182076. Price codes: E03 in paper copy, E03 in microfiche. Report No. STF21-A87111, December 29, 1987. 16p, 13 fig, 2 tab, 6 ref.

Descriptors: *Oil spills, *Shores, *Fate of pollutants, *Water pollution treatment, Cleanup operations, Biodegradation, Organic compounds, Fertilizers, Biological treatment.

The oil soluble fertilizer Inipol EAP22 has been used on shore as a treatment agent after an accidental marine gas oil contamination on Spitsbergen. A 60% increase in the biodegradation of the aliphatic fraction was obtained as a maximum. Inipol alters the contaminated oil and enhances microbial degradation by: (1) turning the oil from a low quality food for the microbes to a 'high quality' food item; (2) decreasing the viscosity and thereby increasing the possible wash-out; or by (3) neutralizing the polar compounds formed due to photochemical and microbial action, and may thus decrease the adsorption of the oil to sediment. (Lantz-PTT)
W89-03741

ENVIRONMENTAL PROJECTS: VOLUME 5. PART ONE: STUDY OF SUBSURFACE CONTAMINATION, PART TWO: GUIDE TO IMPLEMENT ENVIRONMENTAL COMPLIANCE PROGRAMS.
Jet Propulsion Lab., Pasadena, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as N88-20741. Price codes: A10 in paper copy, A01 in microfiche. Report No. JPL Publication 87-4, April 15, 1988. 224p, 40 fig, 6 tab, 6 append. Contract NAS7-918.

Descriptors: *Water pollution sources, *Groundwater pollution, *Regulations, *Water pollution prevention, *Hazardous wastes, Landfills, Organic compounds, Industrial wastes, Leachates, Path of pollutants.

In support of the national goal of the preservation of the environment and the protection of human health and safety, the National Aeronautics and Space Administration, the Jet Propulsion Laboratory, and the Goldstone Deep Space Communications Complex have adopted a position that their operating installations shall maintain a high level of compliance in regard to regulations on environmental hazards. An investigation carried out by a private contractor focused on possible underground contamination that may have resulted from leaks and/or spills from storage facilities at the Goldstone Communications Complex. It was reported in 1985 that 20 tons of hazardous wastes were generated at the GDSCC including waste oils, cleaning solvents, antifreeze, acids and bases, spent batteries, paints, and thinners. A large portion of these wastes was transported off-site for recycling. The remainder went off-site to permitted hazardous waste disposal facilities. The GDSCC also operates an on-site, Class III solid waste landfill. This facility is permitted to receive non-hazardous solid waste generated at the GDSCC including garbage, grass and tree clippings, construction debris, and paper materials. The specific duties and responsibilities of an Operations and Maintenance (O and M) Contractor at the Goldstone Deep Space Communications Complex (GDSCC) are described. These duties and responsibilities also are applicable to the O and M Contractors at other facilities of similar size and function and range from the monitoring and abatement of hazardous and solid wastes, through the management of pesticides, to the environmental training of a Complex's personnel. (Lantz-PTT)
W89-03743

INSTALLATION RESTORATION PROGRAM, PHASE I - RECORDS SEARCH, AIR FORCE PLANT NO. 26, OHIO.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-03748

INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 6, GEORGIA.
CH2M Southeast, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W89-03750

INSTALLATION RESTORATION PROGRAM. PHASE I - RECORDS SEARCH, MCCONNELL AFB, KANSAS.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-03751

WASP4, A HYDRODYNAMIC AND WATER QUALITY MODEL - MODEL THEORY, USER'S MANUAL, AND PROGRAMMER'S GUIDE.
Environmental Research Lab., Athens, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-185095. Price codes: A14 in paper copy, A01 in microfiche. Report No. EPA 600/3-87/039, January 1988. 297p, 50 fig, 62 tab, 86 ref, 5 append.

Descriptors: *Path of pollutants, *Computer programs, *Water quality management, *Model studies, *Handbooks, *Hydrodynamics, *Water Quality Analysis Simulation Program, Estuaries, Water quality, Aquatic environment, Rivers, Lakes, Streams, Coastal waters, Simulation analysis, Dissolved oxygen, Biological oxygen demand, Nutrients, Eutrophication, Organic compounds, Heavy metals, Sediments.

The Water Quality Analysis Simulation Program Version 4 (WASP4) is a dynamic compartment modeling system that can be used to analyze a variety of water quality problems in a diverse set of water bodies. WASP4 simulates the transport and transformation of conventional and toxic pollutants in the water column and benthos of ponds, streams, lakes, reservoirs, rivers, estuaries, and coastal waters. The WASP4 modeling system covers four major subjects--hydrodynamics, conservative mass transport, eutrophication-dissolved oxygen kinetics, and toxic chemical-sediment dynamics. The WASP4 modeling system consists of two stand-alone computer programs, DYNHYD4 and WASP4, that can be run in conjunction or separately. The hydrodynamic program, DYNHYD4, simulates the movement of water and the water quality program, WASP4, simulates the movement and interaction of pollutants within the water. The latter program is supplied with two kinetic sub-models to simulate two of the major classes of water quality problems--conventional pollution (dissolved oxygen, biochemical oxygen demand, nutrients, and eutrophication) and toxic pollution (organic chemicals, heavy metals, and sediment). The substitution of either sub-model constitutes the models EUTRO4 and TOXI4, respectively. (Author's abstract)
W89-03753

SUSPENDED-SEDIMENT, BOTTOM-MATERIAL, AND ASSOCIATED-CHEMICAL DATA FROM THE LOWER MISSISSIPPI RIVER, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-03755

INTERIM ASSESSMENT: THE CAUSES AND EFFECTS OF ACIDIC DEPOSITION. VOLUME 1: EXECUTIVE SUMMARY.
National Acid Precipitation Assessment Program, Washington, DC. Office of the Director of Research.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003899. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/NBM--8003899. (1987). 100p, 14 ref, 5 append.

Descriptors: *National Acid Precipitation Assessment Program, *Air pollution effects, *Acid rain effects, *Acid rain, *Path of pollutants, *Water pollution effects, *Water pollution sources, Fate of pollutants, Acidity, Air pollution.

The causes and effects of acid rain were assessed. The origin of the precursor emissions by source and location, the chemical transformation and transport of the precursors and their products and their deposition on receptor areas were studied. The effects that result from ambient levels of deposition on selected receptors are also discussed. Scientific information from the National Acid Precipi-

tation Assessment Program (NAPAP) research since beginning of the program through early 1987. NAPAP scientists interact both formally and informally with other acidic deposition researchers, both in the U.S. and abroad. Results of other U.S. and foreign studies are included as appropriate but no attempt has been made to cover these in a comprehensive manner. For the sake of convenience, the Interim Assessment is divided into four volumes: Volume I, Executive Summary; Volume II, Emissions and Controls; Volume III, Atmospheric Processes and Deposition; and Volume IV, Effects of Acidic Deposition. The Executive Summary volume describes the origin of NAPAP, the purpose of the Interim Assessment, the definition of acid rain, and some general principles regarding the acidic deposition phenomenon. The centerpiece of the Executive Summary is the Major Conclusions section, derived from the more detailed conclusions of each individual subject chapter. Some conclusions that cut across multiple subject areas are also included in an effort to provide a more synoptic focus. (Lantz-PTT)
W89-03774

ANNUAL REPORT, 1985: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
National Acid Precipitation Assessment Program, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-003898. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/NBM--8003898, 1985. 113p, 27 fig, 21 tab.

Descriptors: *Air pollution effects, *Acid rain effects, *Water pollution effects, *Acid rain, *Water pollution sources, Sulfur, Ozone, Regulations, Air pollution, Monitoring, Environmental effects, Water pollution control.

In 1985, the fourth full year of research under the National Acid Precipitation Assessment Program (National Program), activities have focused on quantifying, testing, and reducing the uncertainties associated with concepts laid out during the first three years of the National Program. Additional efforts have been directed toward the development of new concepts, an activity made possible by improvements in scientific understanding. Significant advances of the National Program during 1985 include: Natural Sources - completed a field study of natural sulfur emissions from terrestrial sources in the middle and eastern U.S., assessed methods for measuring nitrogen oxide fluxes from soils by comparing two different techniques: chamber and gradient, and developed and demonstrated a method for establishing the background levels of ozone at a given site; Man-Made Sources - initiated work to produce a detailed 1985 Emissions Data Base, released a detailed 1980 Emissions Data Base design. Version 4.0 of the 1980 detailed emission data base was made available to other NAPAP Task Groups, Compiled Current Emissions Data Base, Refined the Historical Emissions Data Base; Atmospheric Processes - completed the development of Version I of the Regional Acid Deposition Model (RADM) and demonstrated its ability to predict deposition during three day storms, carried out second field study of the urban contribution to acid rain for Philadelphia, conducted two major field studies through the Processing of Emissions by Clouds and Precipitation (PRECP) program; Deposition Monitoring - installed 8 new National Trends Network stations in the western U.S.; Aquatic Effects - completed a final draft report of the Eastern Lake Survey as part of the National Surface Water Survey; Terrestrial Effects - conducted field experiments with a variety of important agricultural crops which have indicated that these crops are unaffected by current levels of rainfall acidity in the northeastern U.S. (pH 4.2-4.5 growing season averages) compared to rain in remote clean areas (pH 5.0-5.1); Materials and Cultural Resources; and Control Technologies. (Lantz-PTT)
W89-03775

FATE AND EFFECTS OF DISPERSED AND NON-DISPERSED OIL IN ARCTIC MUDFLATS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
P. Sveum.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-181813. Price codes: E02 in paper copy, E03 in microfiche. Report No. STF21-A87119, December 29, 1987. 19p, 10 fig, 4 tab, 21 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Oil pollution, *Arctic zone, *Mud flats, *Cleanup operations, Polar regions, Sediments, Soil bacteria, Dispersants, Water pollution treatment, Oil spills.

The use of dispersants on the sea shore has been used to such an extent and with such harmful effects that bad reputation has been established. The main idea of the present experiments have been to evaluate how three different dispersants affect the biodegradation of oil, the physical removal of oil and the sediment-living microfauna and flora of oil-contaminated mud flats on Spitsbergen. The microflora that inhabits the studied arctic mud flats on Spitsbergen responds to oil pollution with an increase in microbial numbers. The addition of the dispersant OSR5 enhances the increase in cell numbers. Despite the large increase in bacterial cells in sediments treated with OSR5, the increase in the metabolically active bacterial fraction is larger when the oil is treated with Corexit 7664. The number of nematodes in the sediment decreases after oil contamination, and also with the treatments of different dispersants. However, the relative fraction of bacterial feeding nematodes increases in all the contaminated plots. There is a connection between relative toxicity of oil and dispersant and the metabolically active fraction of bacterial cells. The biological degradation of the aliphatics is most extensive in the plots treated with dispersants. Dispersants enhances biodegradation and Corexit 7664 which is found to give the largest increase in metabolically active bacterial cell number, also enhances biodegradation of the aliphatics mostly. The biodegradation of the aliphatics is found to be higher under light exposure than in darkness. Treatment with dispersants enhances physical removal of oil from the sediment. Altogether the results of these experiments indicate that the use of chemical treatment methods might be a strategy worth considering on arctic mud flat sediments. There might be a potential for the development of a low toxic nutrient containing chemicals that enhances both physical removal and biodegradation of the oil. (Lantz-PTT)
W89-03777

GEOLOGY, WATER MOVEMENT, AND SEDIMENT CHARACTERISTICS OF THE SUGAR, ROMAINE, AND ROCK CREEK BASINS, JEFFERSON COUNTY, MISSOURI,
Geological Survey, Rolla, MO.
M. J. Kleeschulte, and J. W. Duley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 85-30-EG, March 1985. 49p, 12 fig, 6 tab, 18 ref.

Descriptors: *Dioxin, *Missouri, *Path of pollutants, *Water pollution sources, *Sugar Creek, *Romaine Creek, *Rock Creek, *Sediment transport, Pollutant transport, Missouri, Runoff, Suspended sediment, Fate of pollutants.

During 1983 the U.S. EPA requested the U.S. Geological Survey and the Missouri Department of Natural Resources to study the geology, water movement, and sediment characteristics of Sugar, Romaine, and Rock Creek basins in Jefferson County, Missouri. The information was needed because the EPA had confirmed the presence of dioxin contamination at Bubbling Spring Horse Arena and on properties in Romaine and Rock Creek basins. Streambed sampling in the upstream reaches of Romaine Creek shows that dioxin is leaving the sites. Because dioxin strongly adsorbs onto fine sediments, it is believed to be transported with the sediments by water erosion. Sediment yields from two sampling sites along Romaine Creek generally were small during base-flow periods; however, instantaneous storm-runoff sediment discharges as large as 1.7 lbs/sec occurred at the downstream site. Typical instantaneous sediment discharges during storm-runoff sampling ranged from <0.1 to 0.5 lb/sec. More than 99% of the suspended sediment was of silt- or clay-size particles (fines); this was true for both base-flow and storm-runoff periods. Suspended sediment collected during the storm of October 20, 1983, was analyzed for dioxin. At the upstream site, the dioxin concentration was 15.3 parts per billion (ppb) in the sediment, but none was detected in the residual water layer at a detection limit of 1 ppb. No dioxin was detected at the downstream site in either the sediment or residual water layer at the 1 ppb detection limit. (Lantz-PTT)
W89-03779

RELATIONSHIP BETWEEN PRECIPITATION QUALITY, SHALLOW GROUND-WATER GEOCHEMISTRY, AND DISSOLVED ALUMINUM IN EASTERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
L. J. Bachman, and B. G. Katz.
Report No. PPSP-AD-14, April 1986. 37p, 7 fig, 4 tab, 30 ref, append.

Descriptors: *Acid rain effects, *Water pollution sources, *Geochemistry, *Maryland, *Groundwater pollution, *Aluminum, *Acid rain, Precipitation, Chemical analysis, Bicarbonate, Silica, Potassium, Sulfates, Water quality, Aquifers.

Precipitation, surface water, and shallow groundwater samples were collected in eastern Maryland to determine if acidic precipitation is affecting the chemical quality of water in the Columbia aquifer - an unconsolidated sand and gravel deposit. Groundwater and surface water samples contained chemical species with significantly different concentration from those of precipitation. Groundwater samples were enriched with bicarbonate, silica, potassium, chloride, and sulfate and had a lower pH than precipitation and groundwater. Surface water samples also had higher dissolved aluminum concentrations than groundwater, commonly exceeding 1 mg/L. Dissolved aluminum in most of the other groundwater samples was at or near the detection limit of 0.01 mg/L. The principal chemical reaction operating in the saturated zone appears to be the incongruent dissolution of microcline to kaolinite. This reaction may occur in two steps, the first of which mobilizes aluminum and silica and consumes hydrogen ion. As the reaction proceeds, kaolinite is formed, removing aluminum and silica from solution. Thus, water in the aquifer would not be expected to have increased dissolved aluminum concentrations. However, aquifer water that discharges to streams before the second step of the reaction is complete (prior to neutralization of hydrogen ion) may have high aluminum concentrations. This corresponds qualitatively to the observed differences in dissolved aluminum in surface water and groundwater. (Lantz-PTT)
W89-03782

USING MODELS TO SOLVE GROUND WATER QUALITY PROBLEMS,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 5G.
W89-03790

TWIN LAKE TRACER TESTS: LONGITUDINAL DISPERSION,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 2F.
W89-03800

TWIN LAKE TRACER TESTS: TRANSVERSE DISPERSION,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2F.
W89-03801

STOCHASTIC ANALYSIS OF SOLUTE ARRIVAL TIME IN HETEROGENEOUS POROUS MEDIA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-03809

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: I. THEORY,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-03810

MULTICOMPONENT MASS TRANSPORT WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS: EFFECT OF THE CHEMISTRY ON THE CHOICE OF NUMERICAL ALGORITHM: II. NUMERICAL RESULTS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-03811

COUPLED GROUNDWATER FLOW AND SOLUTE TRANSPORT WITH FLUID DENSITY STRONGLY DEPENDENT UPON CONCENTRATION,
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
For primary bibliographic entry see Field 2F.
W89-03815

DAGAN MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: APPLICATION TO THE BORDEN SITE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
D. A. Barry, J. Coves, and G. Sposito.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1805-1817, October 1988. 8 fig, 2 tab, 33 ref.

Descriptors: *Path of pollutants, *Plumes, *Groundwater pollution, *Model studies, *Groundwater movement, *Solute transport, Mathematical models, Aquifers, Dagan model, Tracers.

An ensemble-mean convection-dispersion equation (CDE) for tracer solute transport subject to a random velocity field was derived in a previous paper. The model dispersion coefficients originally presented by Dagan (1984) could be derived from the general expression for the dispersion coefficients in this mean CDE. Under the assumption of ergodicity, the Dagan model is used in this paper to predict chloride and bromide concentrations in the well-documented Borden aquifer experiment. Because of a possible influence on the solute from the upper aquifer boundary, it was appropriate to apply the 2-dimensional form of the model. A number of steps was necessary to reduce the 3-dimensional raw data to a 2-dimensional form, the main ones being integration over the vertical axis and the use of a gridding algorithm to form a 2-dimensional solute concentration surface. Incomplete sampling of the solute plume during the early sampling sessions, as well as the assumptions made with respect to the data analysis, produce a rather large degree of uncertainty in the specification of the initial solute plume. These factors hinder a thorough experimental evaluation of the Dagan model. Data from some of the later sampling sessions were more complete, however, and the model predictions appeared to agree well with the field concentration data, especially in the preasymptotic region for the longitudinal dispersion coefficient. (Author's abstract)
W89-03817

NONPARAMETRIC METHOD FOR ESTIMATING THE JOINT PROBABILITY DENSITY OF BOD AND DO,
North Carolina Univ. at Charlotte. Dept. of Mathematics.
K. W. Chen, and A. S. Papadopoulos.
Ecological Modelling ECMOOT, Vol. 41, No. 3/4, p 183-191, June 1988. 1 fig, 2 tab, 12 ref.

Descriptors: *Water pollution, *Mathematical models, *Biological oxygen demand, Dissolved oxygen.

A nonparametric probability estimator, having a uniform biochemical-oxygen demand (BOD) kernel, is utilized to obtain the joint probability density function of BOD and dissolved oxygen (DO) along the stretch of a stream when the pollutant is discharged over an interval and the velocity is distance-dependent. Furthermore, probabilistic confidence bounds for BOD and DO are derived. An example and computations are presented to illustrate the usefulness of the model. (Author's abstract)
W89-03821

SOLUTE TRANSPORT UNDER NO-TILL FIELD CORN,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Gish, and C. B. Coffman.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1358-1363, September-October 1987. 3 fig, 1 tab, 29 ref.

Descriptors: *Path of pollutants, *Soil-water-plant relationships, *Nonpoint pollution sources, *Solute transport, *Corn, *Groundwater movement, Stochastic process, Radioactive tracers, Evapotranspiration.

The movement of a bromide tracer through an established no-till corn field (0.11 ha) was determined. The tracer was uniformly applied in solution as a spray (112 kg KBr/ha). All meteorological events were monitored and used to calculate water inputs and evapotranspiration. Soil cores were taken before and during the experiment to measure bromide transport. A stochastic representation of the one-dimensional (vertical) soil water velocity and a transformed time variable were employed to model the tracer's movement. The first moment of the log normal velocity distribution was assumed to be equivalent to the net water input rate divided by the space and time averaged water content. The only fitted model parameters were the dispersivity and the variance of the velocity distribution. Agreement between model and observed data was good, r2=0.87, especially considering that the entire growing period was simulated. the bromide center of mass for each sampling time was highly correlated to simple displacement theory approximations (r2=0.99). Under no-till dry land conditions, convection apparently is still the dominant transport mechanism. Comparison between theoretical model and field data indicates that even with plants present most of the variability associated with chemical dispersion can be attributed to the water velocity. (Author's abstract)
W89-03828

GLEAMS: GROUNDWATER LOADING EFFECTS OF AGRICULTURAL MANAGEMENT SYSTEMS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
R. A. Leonard, W. G. Knisel, and D. A. Still.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1403-1418, September-October 1987. 9 fig, 5 tab, 53 ref.

Descriptors: *Path of pollutants, *Nonpoint sources, *Pesticide, *Mathematical models, *Root zone, Farm management, Groundwater loading effects.

GLEAMS (Groundwater Loading Effects of Agricultural Management Systems) is a mathematical model developed for field-size areas to evaluate the effects of agricultural management systems on the movement of agricultural chemicals within and through the plant root zone. This paper describes the concepts of the hydrology, erosion, and pesticide components of GLEAMS. Results of sensitivity analysis and validation with observed bromide and pesticide data are given. The validation includes comparisons of model simulations and observed soil concentrations in the root zone, and simulated and observed leaching losses. (Author's abstract)
W89-03834

ROLE OF GRAVEL-PIT LAKES IN THE REMOVAL OF NITRATE FROM PHREATIC AQUIFERS OF THE GARONNE VALLEY: AN ATTEMPT AT AN EVALUATION (ROLE DES LACS DE GRAVIERES DANS LA DIMINUTION DES TENEURS EN NITRATES DES AQUIFERES ALLUVIAUX DE LA VALLEE DE LA GARONNE: ESSAI DE QUANTIFICATION).
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
J. Labroue, J. N. Tourenq, C. Mieussens, J. Robert, and B. Donville.
Annales de Limnologie ANLIB3, Vol. 24, No. 1, p 31-38, 1988. 9 fig, 16 ref. English summary.

Descriptors: *Garonne River, *Drinking water, *Lakes, *Gravel, *Denitrification, *Aquifers, *Groundwater, Purification, Nitrates, Water quality, France, Surface-groundwater relations.

By constructing a budget for inputs and outputs of nitrate in several gravel-pit lakes and directly measuring denitrification through the emission of N2O (using the acetylene method), it was possible to evaluate the depolluting activity in these lakes in relation to the phreatic water of the Garonne. The highest denitrification activity was measured in an old lake that was not clogged and was artificially enriched. In contrast, there was no activity in recently opened gravel pits nor in clogged old gravel pits. Very large water surfaces are necessary in order to purify sufficient flow and provide a supply of piped drinking water. (Author's abstract)
W89-03844

WATER QUALITY VARIATIONS DURING A FLOOD EVENT IN THE ANNAN RIVER, NORTH QUEENSLAND,
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
B. T. Hart, G. Day, A. Sharp-Paul, and T. Beer.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 39, No. 2, p 225-243, 1988. 9 fig, 3 tab, 25 ref.

Descriptors: *Mine wastes, *Mining, *Path of pollutants, *Australia, *Water quality, *Floodwater, Floods, Rivers, Flooding, Flood data, Variability, Suspended solids, Ions, Metals, Annan River, Water chemistry.

Variations in water quality (conductivity, pH, suspended solids, Na, K, Ca, Mg, Cl, SO4, HCO3 and Si) during a major flood event that occurred in the Annan River, north Queensland, on 21 March 1985 are reported. Factor analysis showed that dilution of base flow concentrations by surface runoff was the dominant influence during the rising stage of the flood event, possibly with some flushing of ions from the surface layers of the catchment soils also occurring. At low river flow, the water quality was dominated by that in ground water and possibly interflow. Heavy metals were mostly transported in particulate forms (Fe 99%; Mn 95%; Pb, Zn, Sn 80%; Cu 60%). Filterable metal concentrations were low and changed little with flow. (Author's abstract)
W89-03856

NITROGEN AND PHOSPHORUS IN STREAMWATERS FROM ADJACENT PASTURE, PINE, AND NATIVE FOREST CATCHMENTS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
A. B. Cooper, and C. E. Thomsen.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 279-291, 1988. 4 fig, 7 tab, 52 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Nitrogen, *Phosphorus, *Stream pollution, *Agricultural runoff, *Catchments, Pastures, Agricultural watersheds, Forest watersheds, New Zealand.

Measurements were made of nitrogen (N) and phosphorus (P) concentrations in streams draining three adjacent catchments of different land use. Generally, the pasture catchment stream showed highest concentrations of N and P, compared to the streams draining the pine and native catchments. Total N export coefficients (kg/sq km/year) were estimated as 1195, 131, and 367 for the pasture, pine, and native catchments, respectively. Total P export coefficients (kg/sq km/year) were estimated as 167, 9.5 and 12.0 for pasture, pine, and native catchments, respectively. Exports of N and P from the pasture catchment were unevenly distributed through the year, with most export occurring as particulate forms during storm events. By comparison, export from the two forested catchments was more evenly distributed and baseflow dissolved forms of N and P formed a higher proportion of total export. The influences of land use were attributable to differences in hydrology, source materials of N and P available for transport, and rates of upstream processing. (Author's abstract)
W89-03868

EXCESS NITROGEN DEPOSITION: ISSUES FOR CONSIDERATION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 5C.
W89-03873

RESPONSE TO HEAVY NITROGEN APPLICATIONS IN FERTILIZER EXPERIMENTS IN BRITISH FORESTS,
Aberdeen Univ. (Scotland). Dept. of Forestry.
For primary bibliographic entry see Field 5C.
W89-03874

ECOSYSTEM EFFECTS OF ATMOSPHERIC DEPOSITION OF NITROGEN IN THE NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 5C.
W89-03875

BIOLOGICAL NITRIFICATION OF COVERED RESERVOIRS CONTAINING CHLORAMINATED WATER,
Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W89-03882

MODELING THE TRANSPORT OF INORGANIC IONS THROUGH UNDISTURBED SOIL COLUMNS FROM TWO CONTRASTING WATERSHEDS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2G.
W89-03900

DISTRIBUTION OF SELENIUM IN SOILS OF AGRICULTURAL FIELDS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. Fujii, S. J. Deverel, and D. B. Hatfield.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 5, p 1274-1283, September-October 1988. 6 fig, 6 tab, 32 ref.

Descriptors: *Leaching, *Selenium, *Agricultural runoff, *Water pollution sources, *Soil chemistry, *California, *San Joaquin Valley, Adsorption, Models, Leachates, Dissolved solids, Alluvial fans, Salinity, Soil contamination, Groundwater pollution, Path of pollutants.

Soils from three agricultural fields in the Panoche Creek alluvial fan area in the western San Joaquin Valley, California, were analyzed for soluble, adsorbed, and total concentrations of selenium (Se) to assess the distribution and forms of Se in relation to the leaching of Se from soils. This assessment is needed to evaluate the importance of soil Se in affecting groundwater concentrations. Soil samples were collected from three fields with drainage systems of different ages (6, 15, and 1.5 yr) and different Se concentrations in drain water (58 430, and 3700 micrograms/liter, respectively). Concentrations of soluble Se and salinity were highest in soils from the field drained for 1.5 yr and lowest in the field drained for 6 yr. Of the total concentration of soil Se from all three fields, the proportion of adsorbed and soluble Se ranged from 1 to 11% and <1 to 63%, respectively. Most of the soluble Se was present as selenate and most of the adsorbed Se was found to be selenite. Consistent with a model of evaporative concentration of Se and salinity in soils and shallow groundwater in this area, most of the variance in soluble Se is explained by salinity (r squared > 0.68) in saturation extracts of soils sampled from below the water table. In contrast, most soluble salts and Se apparently have been leached from the unsaturated soils in the fields drained for 6 and 15 yr. For the leached soils, dissolution and precipitation of evaporite minerals containing Se may no longer control concentrations of soluble Se. (Author's abstract)
W89-03901

MIGRATION OF PETROLEUM PRODUCTS THROUGH SANDY HYDROGEOLOGIC SYSTEMS,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
A. S. Abdul.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 73-81, Fall 1988. 11 fig, 16 ref.

Descriptors: *Oil pollution, *Path of pollutants, *Infiltration, *Groundwater pollution, *Groundwater movement, Permeability coefficient, Soil porosity, Sand, Water table, Aquifers, Petroleum products, Leakage.

Laboratory column experiments were carried out to study the migration of petroleum products through a sandy porous medium. It was found that the oil pressure needed to displace water from the pores of the sand medium increased with depth below the top of the column. While oil under negative pressure displaced water through the variably unsaturated zone, a significant vertical column of soil was needed to displace water from the pores at the water table. These results indicate that oil penetration to and below the water table will occur only if the porous medium is highly conductive and the rate of oil leak is high. For small to moderate leak rates and hydraulic conductivities, oil would preferentially spread laterally through the zones above the water table. This process of spreading could serve as a natural barrier to severe aquifer contamination by petroleum products. A simplified procedure was developed to give an order-of-magnitude estimate of the preferred subsurface migration pathways of leaked petroleum products. This procedure utilizes the main drainage and wetting curves for oil and water and the interfacial pressure between these two fluids. This approach could be useful in guiding exploratory investigations, reducing both the risk for further spreading of the contaminants and the investigative cost. (Author's abstract)
W89-03921

CHANGES IN VOLATILE ORGANIC CHEMICAL CONCENTRATIONS AFTER PURGING SLOWLY RECOVERING WELLS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W89-03924

HYDROGEN PEROXIDE TREATMENT OF SEPTIC SYSTEMS AND ITS NEGATIVE EFFECTS ON SHALLOW GROUND WATER,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W89-03926

FARMERS, FERTILISERS AND THE NITRATE FLOOD,
Rothamsted Experimental Station, Harpenden (England).
T. Addiscott.
New Scientist NWSCAL, Vol. 120, No. 1633, p 50-54, October 1988.

Descriptors: *Nitrates, *Path of pollutants, *Agricultural runoff, *Fertilizers, *Nitrogen, Water pollution effects, Leaching, Organic matter, Manure, Groundwater pollution, Water pollution sources.

Although nitrogen fertilizers are beneficial to crop growth, too much nitrogen in agricultural runoff has caused pollution in lakes, rivers and streams. All nitrogen that is available to crops also becomes vulnerable to leaching in soil. In porous rocks, the nitrate may be carried down to a water table 50 meters or more beneath the surface where it may contaminate aquifers used for drinking water. Nitrogen remains in the soil because it may be washed away by rain or the crop has ceased to use it. Leakage of nitrogen is greater in the winter because rainfall usually exceeds evaporation and arable soil is either bare or carrying a young crop that has little demand for nitrogen. Experiments at Rothamsted Experimental Station support the contention that excess nitrogen in soil is the form most responsible for nitrate pollution. Leakage of excess nitrogen continues for a very long time, sometimes taking 41 years to decline to half its initial rate. More research is needed on the ability of microbes to break down organic matter and thus contribute to nitrate pollution. Effective ways to prevent nitrate leakage when agricultural land is not in use and to plant grasses or turn surplus fields over to forestry. Several farming practices are suggested to reduce nitrates causing pollution: (1) do not apply nitrogen fertilizer in autumn; (2) do not leave the soil bare during winter; (3) sow winter crops early in autumn; (4) if a spring crop is to be sown, grow a winter catch crop; (5) use animal manures judiciously; (6) do not plow up too large a proportion of the grassland in any one area at any particular time; (7) plow in straw to lock up some nitrate in organic matter; (8) use nitrogen fertilizer strictly in accordance with professional advice and apply it only when the crop is growing actively. (Geiger-PTT)
W89-03935

CONTRASTING BEHAVIOUR OF DISSOLVED AND PARTICULATE NICKEL AND ZINC IN A POLLUTED ESTUARY,
Water Research Centre, Medmenham (England). Medmenham Lab.
J. A. Campbell, K. Whitelaw, J. P. Riley, P. C. Head, and P. D. Jones.
Science of the Total Environment STENDL, Vol. 71, No. 2, p 141-155, May 1988. 4 fig, 3 tab, 23 ref.

Descriptors: *Path of pollutants, *Nickel, *Zinc, *Estuaries, *Metals, *Trace metals, Water sampling, Pollutants, Geochemistry, Discharge measurement, Salinity, Sediments, Hydrology, Interstitial water, Particulate matter, Tidal effects.

The distributions of dissolved and particulate nickel and zinc in the Mersey estuary have been studied in a series of surveys covering the period 1980-1984. Sampling exercises were conducted over a range of tidal and river flow conditions. For both elements, metal versus salinity plots indicated inputs of dissolved nickel and zinc in the middle and upper estuary. This suggested that the influx of nickel originated from industrial discharges to the narrow upper estuary, while discharges of untreated domestic wastewater accounted for the pronounced maximum in the zinc distribution of salinities in the region 20-25 percent. The influence of release of dissolved zinc by physical disturbance of sediments and mixing of interstitial waters was also recognized. Dispersion of the zinc anomaly appeared to be controlled by hydrological, meteorological and tidal conditions. Particulate metal distributions reflect the different partitioning of nickel and zinc in suspended solids, nickel being associat-

ed more with refractory components while zinc occured in association with organic phases. (Author's abstract)
W89-03936

ANALYSIS OF THE REAL-TIME MEASUREMENT OF THE PH OF RAINFALL AT PADOVA, ITALY: SEASONAL VARIATION AND METEOROLOGICAL ASPECTS,
Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
D. Camuffo, A. Bernardi, and M. Zanetti.
Science of the Total Environment STENDL, Vol. 71, No. 2, p 187-200, May 1988. 2 fig, 4 tab, 27 ref. Commission of the European Communities Contract EV4V-0051-I.

Descriptors: *Seasonal variation, *Hydrogen ion concentration, *Acid rain, *Italy, *Rainfall, Precipitation, Chemical analysis, Sampling, Weather, Seasonal distribution, Air masses, Wind, Weather forecasting.

Sampling of rainfall was performed on a weekly basis and in real time, to determine the effects of precipitation that are masked by dry deposition or post-precipitation equilibrium values. Three classes of rainfall were established, MA (mainly acid), MB (mainly alkaline), and MN (mainly neutral), based on the mean pH value during rainfall. A second classification, based on the trend of the pH curve at the initial stage of precipitation was made, IA (initial stage more acid than the mean value), IB (more alkaline), IC (more acidic). When a seasonal analysis was made the MA class was much less frequent than expected, and was found to be lowest in winter and highest in autumn. The MB class of rainfall was found most frequently in spring, whereas the MN class was most frequent in summer, when precipitation is mainly in the form of showers or thunderstorms, brought about by local conditions of atmospheric instability. This approach was useful in demonstrating the relationship between acid rain and physical processes, and meteorological conditions involved in the formation and transport of air masses. This approach also proved particularly useful in determining the alkalizing role of both the Bora and the Scirocco winds. (Author's abstract)
W89-03938

CONTAMINATION OF URBAN, INDUSTRIAL, AND CONTINENTAL WATERS BY CHLORINATED HYDROCARBON PESTICIDES ALONG THE MEDITERRANEAN COAST OF MOROCCO,
Institut Agronomique et Veterinaire Hassan II, Rabat (Morocco). Lab. de Toxicologie.
M. Kessabi, A. Elhraiki, and B. Nader.
Science of the Total Environment STENDL, Vol. 71, No. 2, p 209-214, May 1988. 1 fig, 2 tab, 12 ref.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Water pollution, *Urban areas, Morocco, Hexachlorobenzene, Lindane, Aldrin, Heptachlor, DDT, Endrin, Dieldrin, Seasonal variation, Water sampling, Mediterranean Sea, Industrial water, Chemical analysis, Effluents, Gas chromatography, Agricultural chemicals.

Water samples were collected from 21 locations between Tangier and Al Hoceima: nine were urban effluents, four were industrial effluents, and eight continental water. At each location samples were collected in autumn, winter, and spring. After petroleum ether extraction and purification by column chromotography samples were concentrated, then identified and measured by gas-liquid chromatography with an electron capture detector. All these samples were found to be contaminated by chlorinated hydrocarbon pesticides. Hexachlorobenzene, lindane, aldrin and heptachlor were frequently encountered. The contamination was relatively low for endrin and dieldrin and irregular for DDT and its derivatives. The levels detected differed from traces to 0.5 ppm. The areas of high urban density showed the highest contamination, with some seasonal variation. (Stoehr-PTT)
W89-03939

SIZE AND SURFACE TEXTURE OF SEDIMENT IN AN URBAN CATCHMENT,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-03940

BEHAVIOUR OF PESTICIDES IN LAKE KASUMIGAURA, JAPAN,
National Inst. for Environmental Studies, Yatabe (Japan).
H. Shiraishi, F. Pula, A. Otsuki, and T. Iwakuma.
Science of the Total Environment STENDL, Vol. 72, p 29-42, June 15, 1988. 5 fig, 4 tab, 23 ref.

Descriptors: *Lakes, *Water pollution, *Pesticides, *Japan, *Surface runoff, *Mass spectrometry, Oxadiazon, Isoprothiolane, Diazinon, Simetryne, Benthiocarb, Toxicity, Sampling, Chemical analysis, Gas chromatography, Mass spectrometry, Lake Kasumigaura, Seasonal variation.

Pesticides such as oxadiazon, isoprothiolane, diazinon, IBP, simetryne and benthiocarb, from surface runoff from rice paddy fields to Lake Kasumigaura, Japan were examined in order to determine seasonal changes in their concentrations in the lake water. The highest concentrations were observed near the river mouths during May to August, soon after pesticide application; hence they are transported mainly by surface runoff. Although these pesticides have been reported to be labile, concentrations of some of them, dispersed with the movement of the water, did not decrease rapidly in the natural aquatic environment. The highest concentrations, in 1985, of oxadiazon, isoprothiolane, diazinon, IBP, simetryne, benthiocarb and CSB were 0.66, 0.84, 0.16, 3.24, 3.23, 2.15 and 1.13 ppb, respectively. The relative order of persistence and mobility of pesticides in the lake water was estimated as: isoprothiolane, CSB, simetryne > IBP > diazinon > oxadiazon > and benthiocarb. (Author's abstract)
W89-03941

CORRELATION CLUSTERS IN THE ACCUMULATION OF METALS IN HUMAN SCALP HAIR: EFFECTS OF AGE, COMMUNITY OF RESIDENCE, AND ABUNDANCE OF METALS IN AIR AND WATER SUPPLIES,
Simon Fraser Univ., Burnaby (British Columbia). School of Kinesiology.
J. Moon, A. J. Davison, T. J. Smith, and S. Fadl.
Science of the Total Environment STENDL, Vol. 72, p 87-112, June 15, 1988. 13 fig, 7 tab, 35 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Metals, *Water sampling, *Human hair, Air pollution, Water pollution, Canada, Sampling, Toxicity, Environmental effects, Lead, Cadmium, Aluminum, Iron, Calcium, Magnesium, Barium, Vanadium, Strontium, Manganese, Correlation analysis.

Scalp hair samples taken from 122 children and 27 adults from three native Indian villages in northern Alberta, Canada were analyzed for 32 metals, in an attempt to trace industrial pollution into the human population. To test the hypothesis that hair content reflected accumulation of environmental metals, water and aerometric samples were collected and analyzed for their metal content. These analyses demonstrated that elevated levels of nine metals in hair from children in one of the control villages are correlated with increased levels of metals in water and air. Moreover, increased levels of Cu, but lowest levels of all other metals were found in hair and environmental samples from one control village. Correlation matrices from metals in the hair samples revealed three sets of highly intercorrelated metals: Pb/Cd; Al/V/Fe; Ca/Mg/Sr/Ba. These groups of metals were significantly intercorrelated in the total population, and in both children and adults, or both males and females, as well as when the population was compared according to community of residence. The high levels of Al and V in hair from very young children may reveal a lower selectivity in metal absorption, and a higher risk of toxicity during a period of rapid growth when need for nutritionally essential metals is particularly high. (Author's abstract)
W89-03942

CHARACTERIZATION OF THE PRECIPITATION IN AN URBAN AREA OF THE PO VALLEY, ITALY,
Bologna Univ. (Italy). Dept. of Industrial Chemistry and Materials.
L. Morselli, R. Carrelli, E. Errani, and D. Ferri.
Science of the Total Environment STENDL, Vol. 72, p 151-159, June 15, 1988. 4 fig, 3 tab, 17 ref.

Descriptors: *Urban areas, *Italy, *Precipitation, *Acid rain, Water sampling, Rainfall, Hydrogen ion concentration, Correlation analysis, Regression analysis, Wind, Weather data collections, Chemical analysis.

Rain samples from two stations equipped with both bulk and wet/dry samplers were collected weekly for a year, and analyzed according to standardized monitoring programs. Several correlations among ions were found: Ca(2+)/SO4(2-); Na(+)/Cl(-); NH4(+)/NO3(-); NH4(+)/SO4(2-); NO3(-)/SO4(2-). In this characterization of the deposition over a large city, Bologna, there is a significant difference in the ion spectra between summer and winter, and a good Na/Cl correlation in summer, which can be explained in terms of a different wind origin (i.e., marine), whereas in winter it arises mainly from the Po valley and from other highly industrialized areas. The pH is one of the highest in northern Italy. In the north-western industrial areas there is some contribution from marine spray (especially in the summer) and desert sands (which occur mainly in the spring). These findings, especially when compared with the corresponding wind frequency distribution, emphasize differences in the chemical composition of the rain that are related to the sampling site, to the kind of sampler, bulk or wet/dry, and to the pollution source. They represent a useful means of assessing the environmental condition of the Po Valley. (Author's abstract)
W89-03943

REGIONAL PATTERNS AND LOCAL VARIABILITY OF DRY AND OCCULT DEPOSITION STRONGLY INFLUENCE SULFATE CONCENTRATIONS IN MAINE LAKES,
Maine Univ., Orono. Dept. of Geological Sciences.
S. A. Norton, J. S. Kahl, D. F. Brakke, G. F. Brewer, and T. A. Haines.
Science of the Total Environment STENDL, Vol. 72, p 183-196, June 15, 1988. 5 fig, 3 tab, 21 ref. NSF Grant DEB-78-10641.

Descriptors: *Acid rain, *Water pollution sources, *Maine, *Lakes, *Sulfates, *Deposition, *Lake sediments, Evapotranspiration, Catchment areas, Water pollution, Precipitation, Chemical analysis, Sediments, Chlorides.

There is great uncertainty and large cost in making dry deposition measurements. Evidence is presented based on wet deposition, evapotranspiration, sulfur storage in lake sediments, and sulfate concentrations in lakes and streams in Maine, that the dry deposition flux of sulfur to drainage basins of lakes in Maine ranges from nearly 0 percent to more than 100 percent of wet deposition, even in small areas. The regional pattern of sulfate concentrations in Maine lakes is due to gradients in both wet and dry deposition and variation in evapotranspiration. Patterns are modified locally by lake hydrologic type, elevation, vegetation, and terrestrial drainage basin aspects. (Author's abstract)
W89-03947

DISTRIBUTION OF SILICONES IN WATER, SEDIMENT AND FISH IN JAPANESE RIVERS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
For primary bibliographic entry see Field 5A.
W89-03949

HISTORICAL RECORDS OF SILICONES IN SEDIMENT,
Naval Research Lab., Washington, DC. Chemistry Div.
For primary bibliographic entry see Field 5A.

W89-03950

ENVIRONMENTAL FATE AND ECOLOGICAL IMPACT OF ORGANOSILICON MATERIALS: A REVIEW,
Dow Corning Corp., Midlands, MI. Health and Environmental Sciences Dept.
For primary bibliographic entry see Field 5C.
W89-03951

POSSIBLE METHYLATION OF INORGANIC MERCURY BY SILICONES IN THE ENVIRONMENT,
Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
H. Nagase, Y. Ose, and T. Sato.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 29-38, July 1, 1988. 8 fig, 4 tab, 8 ref.

Descriptors: *Path of pollutants, *Silicone, *Fate of pollutants, *Methylation, *Polymers, *Mercury, *Methylmercury, Heavy metals, Degradation products, Gas chromotography, Mass spectrometry, Pollutants, Chemical analysis, Environmental effects.

Organosiloxanes are being released to the environment in increasing quantities, and there are questions concerning the reactivity of silicones as methylating agents under environmental conditions. Specifically, the interaction of inorganic mercury and polydimethylsiloxanes, and other silicones, to give methylmercury is important in this context. To this end a series of laboratory experiments, in which inorganic mercury, short and long chain silicones, cyclic siloxanes, oxidized silicone gums, and industrial formulations containing silicones, were conducted. In all cases, there was evidence of the production of methylmercury, a finding of potential significance. Analyses for methylmercury and related silicon-containing degradation products were conducted using a combination of gas chromatography, mass spectrometry, and headspace gas analysis. (Author's abstract)
W89-03952

COMPARISON OF THE RATES OF METHYLATION OF MERCURY(II) SPECIES IN AQUATIC MEDIA BY VARIOUS ORGANOTIN AND ORGANOSILICON MOIETIES,
Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
J. M. Bellama, K. L. Jewett, W. F. Manders, and J. D. Nies.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 39-51, July 1, 1988. 9 tab, 27 ref.

Descriptors: *Methylation, *Mercury, *Heavy metals, *Aquatic environment, *Tin, *Methylmercury, *Path of pollutants, *Silicones, Nuclear magnetic resonance, Kinetics, Chemical reactions, Ions, Tin.

Metals can be methylated in environmental aqueous media by a variety of organotin and organosilicon compounds. Main group metals and metalloids were surveyed for the identification of species that can either donate or accept methyl groups. The methylation of mercury(II) by trimethyltin cation was found to be a bimolecular reaction, the reaction rate of which decreased with increasing chloride concentration. Kinetic investigations using NMR techniques showed the most important pairs of reactants. Sodium 2,2,3,3-tetradeutero-3-(trimethylsilyl)propionate (TSP) and sodium 2,2-dimethyl-2-silapentane-5-sulfonate (DSS) were found to methylate mercury(II). Organylsilatranes were found to transfer their organic groups readily to mercury(II) to produce organomercury compounds. (Author's abstract)
W89-03953

ORGANOLEADS IN THE ENVIRONMENT: A REVIEW,
Aston Univ., Birmingham (England). Dept. of Molecular Sciences.
A. W. P. Jarvie.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 121-126, July 1, 1988. 24 ref.

Descriptors: *Water pollution sources, *Reviews, *Lead, *Air pollution, Marine algae, History, Natural waters, Sediments, Soil analysis, Sampling, Toxicity, Biochemistry, Sulfides, Methylation, Chemical analysis, Geochemistry, Environmental effects, Path of pollutants.

The automobile and its use have been proposed as major sources of environmental organolead compounds. However, confirmation of this proposition was not possible until analytical technology evolved to give sufficient sensitivity to detect small quantities of lead species in small samples of environmental materials. It was further hypothesized that various biochemical pathways could convert inorganic lead ion to organolead species, a proposal which has been examined by several groups over many years. Once it was unequivocally established that organolead species can occur in the environment as a result of anthropogenic activity of naturally occurring biotic or abiotic processes, the possible and likely biochemical effects associated with the environmental processes of organolead species reviews. Research in this area has focused on examining the interactions of certain algae with a variety of organolead species. This paper reviews the evolution of environmental organolead biogeochemical research over the past 15 years. (Author's abstract)
W89-03955

ENVIRONMENTAL METHYLATION OF TIN: AN ASSESSMENT,
Leicester Polytechnic (England). School of Chemistry.
J. R. Ashby, and P. J. Craig.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 127-133, July 1, 1988. 1 fig, 32 ref.

Descriptors: *Path of pollutants, *Methylation, *Tin, *Reviews, *Sediments, *Metals, Methylmercury, Mass spectrometry, Toxicity, Environmental effects, Simulation.

The chemical and biological methylation of tin under environmental conditions is reviewed. The question of whether methyltin species form in situ in the environment is also considered. Analytical approaches using hydridization techniques give quite sensitive results. Incubation studies of environmental microorganisms and sediment have demonstrated the formation of methyltin species, and similar conversions have been observed with chemical methylating agents such as methyl cobalamin and methyl iodide. (Author's abstract)
W89-03956

ROLE OF BIOGENIC THIOLS IN THE SOLUBILITY OF SULFIDE MINERALS,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
For primary bibliographic entry see Field 2K.
W89-03957

EFFECTS OF CHEMICAL POLLUTION ON THE ACTIVITIES OF HEPATIC XENOBIOTIC METABOLIZING ENZYMES IN FISH FROM THE RIVER RHONE,
Ecole Nationale Veterinaire de Lyon (France). Lab. d'Ecotoxicologie.
For primary bibliographic entry see Field 5C.
W89-03958

CHARACTERIZATION OF A RURAL AREA IN TERMS OF DRY AND WET DEPOSITION,
Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico.
M. Possanzini, P. Buttini, and V. Di Palo.
Science of the Total Environment STENDL, Vol. 74, p 111-120, August 1, 1988. 2 fig, 3 tab, 24 ref.

Descriptors: *Chemistry of precipitation, *Path of pollutants, *Deposition, *Rural areas, *Air pollution, *Acid rain, *Rainfall, *Aerosols, Particulate matter, Sulfates, Nitrates, Precipitation, Ammonium salts, Denudation.

Atmospheric gaseous pollutants, NO2, SO2, NH3, and HNO3, and related ionic species in water-soluble fine particulates and rainwater were monitored from September 1986 to January 1987 with the aim of estimating the acid deposition over a rural area near Rome. A wet-only rain collector and an annular denuder-filter pack sampling system for gases and aerosols were employed to avoid chemical artifact formation. A comparison of the wet and dry deposition rates indicates that atmospheric removal by precipitation was the dominant sink for sulfate and nitrate at the sampling site. Ion balance analysis showed that the main compounds present in aerosols were ammonium sulfate and ammonium nitrate, since the ammonium neutralization factor approached 100 percent and the acidity content was very low. The marked enrichment of H(+), SO4(--) and NO3(-) in precipitation compared with NH4(+) could be explained by assuming either that SO2 and NO2 are oxidized in cloud droplets or that acidic sulfate and nitrate are scavenged directly in-cloud or below-cloud. (Author's abstract)
W89-03960

ACCUMULATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN AN URBAN SNOWPACK,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. Boom, and J. Marsalek.
Science of the Total Environment STENDL, Vol. 74, p 133-148, August 1, 1988. 3 fig, 8 tab, 24 ref.

Descriptors: *Snowpack, *Path of pollutants, *Water pollution sources, *Aromatic compounds, *Hydrocarbons, *Urban areas, *Urban runoff, Accumulation, Deposition, Toxicity, Industrial plants, Sampling, Pollutants, Water quality, Standards.

Accumulations of polycyclic aromatic hydrocarbons in a snowpack were studied in an industrial urban area with numerous anthropogenic sources of PAHs. Average PAH loadings stored in the snowpack were determined, plotted on a map of the study area, and areal distribution approximated by isoloading contours. The loading contours exhibited a marked elongation in the direction of prevailing winds. The unit-area deposition rates observed in the study area exceeded the typical rates reported for other urban areas, and were the highest immediately downwind of a steel plant. PAH levels in snowmelt were well below the freshwater aquatic life toxicity criteria, but exceeded both the WHO drinking water standard and the U.S. EPA carcinogenic criteria at the 0.00001 risk level. (Author's abstract)
W89-03961

TRACE ELEMENT RESIDUES IN BLUEGILLS AND COMMON CARP FROM THE LOWER SAN JOAQUIN RIVER, CALIFORNIA, AND ITS TRIBUTARIES,
National Fisheries Contaminant Research Center, Dixon, CA. Field Research Station-Dixon.
M. K. Saiki, and T. W. May.
Science of the Total Environment STENDL, Vol 74, p 199-217, August 1, 1988. 3 fig, 8 tab, 39 ref.

Descriptors: *Pollutant identification, *Heavy metals, *Trace elements, *Bluegills, *Carp, *California, *Agricultural runoff, Arsenic, Boron, Cadmium, Chromium, Mercury, Molybdenum, Pollutants, Nickel, Lead, Selenium, San Joaquin River, Statistical analysis, Water quality, Subsurface drainage, Irrigation return flow, Rivers, Path of pollutants.

Whole-body samples of bluegills and common carp from the San Joaquin River and two tributaries were analyzed to determine if the concentrations of any of nine elements were elevated as a result of exposure ot the fish to agricultural subsurface drainage water. Highest concentrations detected were as follows: (first number applies to bluegills and second number to carp) As, 0.97 and 1.5; B, 14 and 20; Cd, 0.14 and 0.27; Cr, 2.7 and 2.2; Hg, 3.3 and 2.9; Mo, 2.8 and 3.6; Ni, 0.87 and 2.2; Pb, 0.26 and 2.3; Se, 3.2 and 5.5. The lowest concentrations were below the levels of detection, except for Hg, 0.15 and 0.12, and Se, 0.43 and 0.56. As judged by comparisons with data from the National Contami-

nant Biomonitoring Program and other published surveys, the concentrations of B, Hg, Mo, and Se were moderately elevated in fish from several sites in the San Joaquin Valley. However, only the Se concentrations were positively correlated with water quality variables known to be influenced by irrigation return flows. (Author's abstract)
W89-03965

VISCOSITY AND DIELECTRIC CONSTANT CONTROLS ON THE HYDRAULIC CONDUCTIVITY OF CLAYEY SOILS PERMEATED WITH WATER-SOLUBLE ORGANICS,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 2G.
W89-03972

APPLICATION OF VARIABLY SATURATED FLOW THEORY TO CLAY COVER LINERS,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-03983

DEVELOPMENT OF A SIMPLIFIED PLANT STOMATAL RESISTANCE MODEL AND ITS VALIDATION FOR POTENTIALLY TRANSPIRING AND WATER-STRESSED WATER HYACINTHS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W89-03995

ALGAE SEQUESTER HEAVY METALS VIA SYNTHESIS OF PHYTOCHELATIN COMPLEXES,
Munich Univ. (Germany, F.R.). Fakultaet Chemie und Pharmazie.
W. Gekeler, E. Grill, E.-L. Winnacker, and M. H. Zenk.
Archives of Microbiology AMICCU, Vol. 150, No. 2, p 197-202, June 1988. 3 fig, 1 tab, 29 ref. Bundesminister fur Forschung und Technologie Grant 321-7291-BZT-0372.

Descriptors: *Algae, *Bioaccumulation, *Heavy metals, *Chelating agents, *Peptides, *Path of pollutants, Accumulation, Chelation, Cadmium, Chlorella, Chlorophyta, Sulfides, Euglena, Euglenophyta, Diatoms, Fragilaria, Chlamydomonas.

Higher plants or plant cell suspension cultures synthesize, upon exposure to a wide range of heavy metals, a series of cysteine-rich peptides called phytochelatins that bind heavy metal ions by thiolate coordination. The ubiquity of phytochelatins was investigated in algae, along with their induction upon exposure to heavy metals. A cadmium-binding complex was isolated from Chlorella fusca and was shown to be composed of phytochelating peptides, (gamma-Glu-Cys)n-Gly, n = 2-5. Members of six of the 10 classes of algae revealed phytochelatin synthesis after exposure to cadmium ions. Phytochelatin was also induced by ions of lead, zinc, silver, copper, and mercury. The occurrence of free sulfide has been reported previously in Euglena and higher plant Cd-binding complex. The complex purified from Chlorella was found to contain about 12% of the sulfur as sulfide ions. It is concluded that algae sequester heavy metals by the same mechanism as higher plants. (Doria-PTT)
W89-03996

CHLOROBENZOATE CATABOLISM AND INTERACTIONS BETWEEN ALCALIGENES AND PSEUDOMONAS SPECIES FROM BLOODY RUN CREEK,
Toronto Univ. (Ontario). Dept. of Botany.
R. C. Wyndham, and N. A. Straus.
Archives of Microbiology AMICCU, Vol. 150, No. 3, p 230-236, July 1988. 2 fig, 3 tab, 29 ref.

Descriptors: *Chlorinated hydrocarbons, *Biodegradation, *Alcaligenes, *Fate of pollutants, *Pseudomonas, *Aromatic compounds, *Bacteria, Hydrocarbons, Degradation, Runoff, Landfills, Oxygen uptake, Metabolism, Biotransformation, Fate of pollutants, Enzymes, Culturing techniques, Phosphates, Nutrients, Limiting nutrients.

A mixed community of bacteria from surface runoff waters of the Hyde Park, NY industrial landfill was enriched on 3-chlorobenzoate. Alcaligenes and Pseudomonas species were dominant in the community. Alcaligenes sp. BR 60 carried an unstable plasmid specifying 3-chlorobenzoate catabolism. Metabolites included chlorocatechol and chloro-cis,cis-muconic acid. The isolate grew very slowly on benzoate. Alcaligenes sp. BR 60 was isolated in co-culture with Pseudomonas fluorescens NR 52. The latter contained no detectable plasmids and did not grow on benzoate or any of the chlorobenzoates in pure culture. Growth of the co-culture in Bloody Run Creek water supplemented with 3-chlorobenzoate indicated that phosphate concentrations in the water severely limited biodegradation. Under phosphate-limited conditions in continuous culture, Pseudomonas fluorescens NR 52 effectively scavenged available phosphate when it was present at a ratio of 1 cell to 20 of Alcaligenes sp. BR 60. Under these conditions, the growth of Alcaligenes sp. BR 60 on 3-chlorobenzoate was reduced five-fold, the frequency of plasmid deletion mutants increased, and 96% of the contaminant remained in the outflow in the form of the starting material or metabolites. No evidence was found for conjugation of the plasmid determining chlorobenzoate catabolism in Alcaligenes sp. BR 60 to P. fluorescens NR 52. (Author's abstract)
W89-03997

TRANSFORMATIONS OF HALOGENATED AROMATIC ALDEHYDES BY METABOLICALLY STABLE ANAEROBIC ENRICHMENT CULTURES,
Swedish Environmental Research Inst., Stockholm.
A. H. Neilson, A.-S. Allard, P.-A. Hynning, and M. Remberger.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2226-2236, September 1988. 6 fig, 1 tab, 21 ref. Swedish Forest Industry Water and Air Pollution Research Foundation Project Environment 90.

Descriptors: *Biotransformation, *Chlorinated hydrocarbons, *Metabolites, *Aromatic compounds, *Anaerobic bacteria, *Fate of pollutants, Hydrocarbons, Chemical reactions, Sediments, Marine sediments, Water pollution, Culturing techniques, Bacteria, Bacterial physiology, Kinetics, Microbiological studies.

Metabolically stable enrichment cultures of anaerobic bacteria obtained by elective enrichment of sediment samples from the Baltic Sea and Gulf of Bothnia were used to study the oxidation and reduction of the aldehyde group of various halogenated aromatic aldehydes. It was shown that synthesis of the corresponding carboxylic acids, which were the principal metabolites, was invariably accompanied by partial reduction of the aldehyde to a hydroxymethyl group in yields between 3 and 30%. Complete reduction to a methyl group was observed with some of the halogenated vanillins, but to an extremely limited extent with the halogenated 4-hydroxybenzaldehydes. On the basis of the kinetics of formation of the metabolites, it was concluded that the oxidation and reduction reactions were mechanistically related. On prolonged incubation, the halogenated carboxylic acids were generally decarboxylated, so that the final products from these substrates were halogenated catechols or phenols. Reductive processes of the type revealed in this study might therefore plausibly occur in the environment during anaerobic transformation of halogenated aromatic aldehydes containing hydroxyl and/or methoxyl groups. (Author's abstract)
W89-04005

WATER QUALITY DATA FOR THE BOISE RIVER, BOISE TO STAR, IDAHO, MARCH 1988,
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel, and T. F. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $2.75, microfiche $4.75. USGS Open-File Report 88-474, Sept. 1988. 14p, 1 fig, 5 tabs.

Descriptors: *Water quality, *Wastewater disposal, *Water pollution sources, *Boise River, *Idaho, *Benthic invertebrates, Wastewater treatment, Trace elements, Low flow, Artificial substrates, Fish.

Physical and chemical data were collected at six sites and biological data were collected at five sites on the Boise River between Veterans Memorial Parkway in Boise and Star, Idaho, from January to March 1988. Data were collected to determine the effect of sewage effluent from two Boise wastewater treatment facilities on the water and biological quality of the Boise River. Similar data were collected from October to December 1987. Results of all data analyses will be discussed in an interpretive report. (USGS)
W89-04027

STREAMFLOW AND WATER QUALITY DATA FOR THREE MAJOR TRIBUTARIES TO REELFOOT LAKE, WEST TENNESSEE, OCTOBER 1987-MARCH 1988,
Geological Survey, Nashville, TN. Water Resources Div.
M. C. Yurewicz, W. P. Carey, and J. W. Garrett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-311, August 1988, 20p, 2 fig, 7 tab, 9 ref.

Descriptors: *Water pollution sources, *Nonpoint pollution sources, *Agricultural runoff, *Reelfoot Lake, *Tennessee, Pesticides, Nutrients, Sediment, Water quality, Sediment load.

Streamflow and water quality data were collected for three major tributaries to Reelfoot Lake, in West Tennessee, for the period October 1987 through March 1988. The data are presented in graphs and tables. Mean daily discharge data were collected at one site each in the drainage basins of North Reelfoot Creek, South Reelfoot Creek, and Running Slough. Daily mean suspended-sediment concentration data were collected at a site in the North Reelfoot Creek basin. Water quality samples were collected during storm events at the same locations that daily mean streamflow data were collected. Water quality samples were analyzed for concentrations of nutrients and triazine herbicides. Water temperature and specific conductance were measured at the time that samples were collected. (USGS)
W89-04035

SUMMARY OF THE U.S. GEOLOGICAL SURVEY NATIONAL WATER QUALITY ASSESSMENT PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-04041

STATION DESCRIPTIONS AND AVAILABILITY OF DISCHARGE AND WATER QUALITY DATA THROUGH 1985 FOR EASTERN MONTANA STREAM SITES NOT INCLUDED IN THE NATIONAL WATER DATA EXCHANGE PROGRAM,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04042

DOCUMENTATION OF A STEADY-STATE SALTWATER-INTRUSION MODEL FOR THREE-DIMENSIONAL GROUNDWATER FLOW, AND USER'S GUIDE,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.

W89-04048

PROGRESS REPORT ON THE GROUND-WATER, SURFACE WATER, AND QUALITY-OF-WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA - 1987,
Geological Survey, Flagstaff, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04052

STATISTICAL, GRAPHICAL, AND TREND ANALYSES OF SELECTED WATER QUALITY AND STREAMFLOW DATA FROM THE TRINITY RIVER NEAR CROCKETT, TEXAS, 1964-85,
Geological Survey, Houston, TX. Water Resources Div.
R. L. Goss.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-393, 1987. 21p, 12 fig, 2 tab, 4 ref.

Descriptors: *Water quality, *Water properties, *Graphical analysis, *Streamflow, *Statistical analysis, *Texas, Streamflow, Water temperature, Oxygen, Monitoring, Specific conductivity, Trinity River.

Statistical, graphical and trend analysis of selected water quality and streamflow data were collected between 1964 and 1985 at the Trinity River near Crockett, Texas. Results of statistical and trend analyses of the data are presented in tables. Graphs showing the annual compilation of streamflow and water quality data collected by a U.S. Geological Survey flow-through water quality monitor are presented for the period since 1975. (USGS)
W89-04053

DESCRIPTION AND RESULTS OF TEST-DRILLING PROGRAM AT PICATINNY ARSENAL, NEW JERSEY, 1982-1984,
Geological Survey, Trenton, NJ. Water Resources Div.
P. T. Harte, B. P. Sargent, and E. F. Vowinkel.
Available from Books and Open File Report Section, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 86-316, 1986. 54p, 16 fig, 3 tab, 1 pl, 13 ref.

Descriptors: *Test wells, *Water pollution sources, *Path of pollutants, *Hydrogeology, *New Jersey, Lithology, Gamma-ray logs, Bedrock, Glacial deposits, Picatinny Arsenal.

Picatinny Arsenal, located in north-central New Jersey, has a long history of explosives manufacturing. Past industrial activities and past waste-disposal practices have caused some groundwater contamination problems. In 1982, the U.S. Geological Survey, in cooperation with the U.S. Army, began a water resources investigation of the Arsenal. The test drilling program is designed to define the hydrogeology and install observation wells. Twenty-two boreholes were drilled and 21 observation wells installed in these holes. All drilling was done in a glaciated valley. The report includes lithologic and gamma-ray logs, results of grain-size analyses, well-construction data, and some groundwater levels. The generalized stratigraphic sequence of geologic units penetrated from the test-drilling program are from lower to upper: (1) predominantly dolomitic Leithsville Formation, (2) in the upper part of bedrock, a weathered dolomite zone, (3) a thin discontinuous mantle of till, and (4) stratified drift deposit up to 208 ft thick. (USGS)
W89-04060

WATER QUALITY AND HYDROGEOLOGIC DATA FOR THREE PHOSPHATE INDUSTRY WASTE-DISPOSAL SITES IN CENTRAL FLORIDA, 1979-80,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-04061

GENERAL SURFACE AND GROUNDWATER QUALITY IN A COAL-RESOURCE AREA NEAR DURANGO, SOUTHWESTERN COLORADO,
Geological Survey, Grand Junction, CO. Water Resources Div.
D. L. Butler.
Available from Books and Open File Report Section, USGS Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4073, 1986. 53p, 11 fig, 10 tab, 10 ref, 1 pl.

Descriptors: *Coal mining, *Water quality data, *Streams, *Groundwater, *Colorado, Trace elements, Baseline studies, Linear regression analysis, La Plata County, Archuleta County, Mesaverde Group, Animas Formation, Durango.

A general description of surface and groundwater quality in a coal-resource area near Durango, southwestern Colorado is given. Dissolved-solids concentrations were less than 1,000 mg/l in streams, except in the Alkali Gulch, Basin Creek, and Carbon Junction Canyon drainage basins. Median concentrations of dissolved boron, iron, manganese, and zinc were less than 35 microg/l; median concentrations of dissolved lead and selenium were less than 1 microg/l. (USGS)
W89-04063

RAINFALL AND RUNOFF QUANTITY AND QUALITY CHARACTERISTICS OF FOUR URBAN LAND-USE CATCHMENTS IN FRESNO, CALIFORNIA, OCTOBER 1981 TO APRIL 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
R. N. Oltmann, and M. V. Shulters.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-710, 1987. 132p, 30 fig, 35 tab, 13 ref.

Descriptors: *Urban hydrology, *Path of pollutants, *Water pollution sources, *Fresno, *Urban runoff, *Storm loads, *Rainfall quality, *California, Rainfall, Dry deposition, Pesticides, Nutrients, Trace metals, Fresno County.

Rainfall and runoff quantity and quality were monitored for industrial, single-dwelling residential, multiple-dwelling residential, and commercial land-use catchments in Fresno, California, during 1981-82 and 1982-83 rain seasons. Storm-composite rainfall and discrete runoff samples were analyzed for physical, inorganic, organic, and biological constituents. Atmospheric dry-deposition- and street-surface particulate samples also were collected and analyzed. Except for the industrial catchment, highest runoff concentrations for most constituents occurred during initial storm runoff and then decreased throughout the remainder of the storm; constituent concentrations for the industrial catchment fluctuated greatly. Statistical testing of runoff-quality data showed higher concentration for most constituents for the industrial catchment. Lead showed lower concentrations for the industrial catchment than for the other three catchments. Event mean concentration (EMC) for most constituents for all but the industrial catchment were highest for the first two or three storms of the rain season after which they became almost constant; the industrial constituent EMC's generally did not show any pattern. The organophosphorus compounds, parathion, diazinon, and malathion were the most prevalent pesticides detected in rainfall. Other pesticides detected in rainfall included chlordane, lindane, methoxychlor, endosulfan, and 2,4-D. Of these, only methoxychlor and endosulfan were not consistently detected in the runoff. (USGS)
W89-04064

RAINFALL AND RUNOFF QUANTITY AND QUALITY DATA COLLECTED AT FOUR URBAN LAND-USE CATCHMENTS IN FRESNO, CALIFORNIA: OCTOBER 1981 - APRIL 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
R. N. Oltmann, R. Guay, and J. M. Shay.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-718, 1987. 139p, 8 fig, 16 tab, 8 ref.

Descriptors: *Urban runoff, *Urban hydrology, *Hydrologic data collections, *Rainfall, *Pesticides, *Path of pollutants, *California, Runoff, Nutrients, Sediments, Water pollution sources, Fresno, Central Valley, San Joaquin Valley, Metals.

Data were collected as part of the National Urban Runoff Program to characterize urban runoff in Fresno, California. Rainfall-runoff quantity and quality data are included along with atmospheric dry-deposition and street-surface particulate quality data. The data are presented in figures and tables that reflect four land uses: industrial, single-dwelling residential, multiple-dwelling residential, and commercial. A total of 255 storms were monitored for rainfall and runoff quantity. Runoff samples from 112 of these storms were analyzed for physical, organic, inorganic, and biological constituents. The majority of the remaining storms have pH and specific conductance data only. Ninety-two composite rain samples were collected. Of these, 63 were analyzed for physical, inorganic, and (or) organic constituents. The remaining rainfall samples have pH and specific conductance data only. Nineteen atmospheric deposition and 21 street-particulate samples were collected and analyzed for inorganic and organic constituents. The report also details equipment utilization and operation, and discusses data collection methods. (USGS)
W89-04065

EVALUATION OF SELECTED SURFACE WATER QUALITY STATIONS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. J. Rucker, and L. L. Delong.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 82-4003, 1987. 72p, 39 fig, 4 tab, 6 ref.

Descriptors: *Water quality, *Salinity, *Dissolved solids, *Network design, *Hydrologic data, Planning, Regression analysis, Correlation analysis, Dissolved-solids loads.

The U.S. Geological Survey, in cooperation with the Wyoming Department of Agriculture, has conducted a surface-water-quality program in Wyoming since 1965. The purpose has been to determine the chemical quality of the water in terms of the major dissolved constituents (salinity). Changing agricultural techniques and energy development have stimulated a need for an expanded program involving additional types of data. This report determines the adequacy of the data collected thus far to describe the chemical quality. The sampling program was evaluated by determining how well the data describe the dissolved-solids load of the streams. Monthly mean loads were estimated at 16 stations throughout the network where daily streamflow and daily specific conductance were available. Monthly loads were then compared with loads estimated from daily streamflow and data derived from analyses of samples collected on a monthly basis at these same stations. Agreement was good. Solute-load hydrographs were constructed for 37 stations and from some reaches where streamflow records were available. Because stations where no discharge records are available are not amenable to this type of analysis, data collected at these stations are of limited usefulness. This report covers analyses of data for all qualifying sites in Wyoming except those in the Green River Basin, which were analyzed in U.S. Geological Survey Water Resources Investigations 77-103. The salinity in most of the streams evaluated is adequately described by the data collected. Reduced sampling is feasible, and time and money can be diverted to collecting other data. (USGS)
W89-04078

HYDROLOGY OF AREA 28, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
E. E. Zuehls, K. K. Fitzgerald, and C. A. Peters.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 83-544, 1987. 67p, 54 fig, 18 tab, 39 ref.

Descriptors: *Coals, *Coal mines, *Water pollution sources, *Illinois, *Geohydrology, Hydrologic data.

The Eastern Region of the Interior Coal Province is divided into 11 hydrologic reporting areas. Area 28 is located in central Illinois and includes all of the Sangamon River drainage, an area of 5,419 square miles. The southwestern half of the area lies in the Springfield Plain and the northeastern half lies in the Bloomington Ridged Plain physiographic divisions. The entire area is covered with glacial till with a blanket of loess 5 to 10 feet thick on the surface. Pennsylvania rocks with layers of sandstone, limestone, siltstone, shale, clay, and coal underlie about 90% of Area 28. Herrin (No. 6), Harrisburg-Springfield (No. 5), Colchester (No. 2), and Danville (No. 7) coals have been mined in the area. Streamflow and water quality data are collected at a network of hydrologic monitoring stations operated by the U.S. Geological Survey. Streamflow can be estimated at ungaged sites. Water quality was analyzed for specific conductance, pH, alkalinity, dissolved sulfate, total recoverable and dissolved iron and manganese, dissolved solids, and other properties. Groundwater is obtained from unconsolidated materials in almost all of Area 28. (USGS)
W89-04079

PHENOLIC CONTAMINATION IN THE SAND-AND-GRAVEL AQUIFER FROM A SURFACE IMPOUNDMENT OF WOOD TREATMENT WASTES, PENSACOLA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. E. Troutman, E. M. Godsy, D. F. Goerlitz, and G. G. Ehrlich.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4230, 1984. 36p, 9 fig, 6 tab, 22 ref.

Descriptors: *Groundwater pollution, *Wastewater disposal, *Fate of pollutants, *Water pollution sources, *Phenols, *Path of pollutants, *Wood treatment wastes, *Florida, *Pensacola, Waste disposal ponds, Creosote, Pentachlorophenol, Pesticides, Sand aquifers.

Creosote and pentachlorophenol wastewaters discharged to unlined surface impoundments have resulted in groundwater contamination in the vicinity of an industrial site near Pensacola, Florida. Total phenol concentrations of 36,000 microgm/liter have been detected 40 ft below land surface in a test hole 100 ft south of an overflow impoundment but less than 10 microgm/liter 90 ft below land surface. Samples collected in test holes 1,350 ft downgradient from the surface impoundments and 100 ft north of Pensacola Bay, above and immediately below a clay lens, indicate that phenol contaminated groundwater may not be discharging directly into Pensacola Bay. Phenol concentrations exceeding 20 microgm/liter were detected in samples from a drainage ditch discharging directly into Bayou Chico. Microbiological data collected near the test site suggest that an anaerobic methanogenic ecosystem contributes to a reduction in phenol concentrations in groundwater. A laboratory study using bacteria isolated from the study site indicates that phenol, 2-methylphenol, and 3-methylphenol are significantly degraded and that methanogenesis reduces total phenol concentrations in laboratory digestors by 45%. Pentachlorophenol may inhibit methanogenesis at concentrations exceeding 0.45 milligm/liter. (USGS)
W89-04081

DATA FOR SELECTED PESTICIDES AND VOLATILE ORGANIC COMPOUNDS FOR WELLS IN THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA, FEBRUARY TO JULY 1985,
Geological Survey, Sacramento, CA. Water Resources Div.
J. M. Neil.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-48, 1987. 10p, 1 fig, 3 tab, 4 ref.

Descriptors: *Groundwater, *Pesticides, *San Joaquin Valley, *California, *Water pollution sources, *Water quality data, Pollution, Organic compounds, Triazine herbicides.

During February to July 1985, water samples were collected from 55 wells in the western San Joaquin Valley, California, for chemical analysis to determine if 20 selected pesticides and 26 volatile organic compounds were present. Twenty-six of the sampled wells are completed in the shallow unconfined regional aquifer and 29 wells are completed in the deep confined regional aquifer. Water from six of the sampled wells, four of which are completed in the shallow unconfined aquifer, contained detectable levels of the pesticides or volatile organic compounds. Four samples contained a single pesticide, one sample contained two pesticides, and one sample contained 5.9 microgm/liter of toluene, a volatile organic compound. Five of the six pesticides detected were triazine herbicides; the maximum concentration was 0.2 microgm/liter. Four samples with detectable concentrations of triazine herbicides are from wells used for domestic water supply; however, drinking-water standards have not been established for triazine herbicides. (USGS)
W89-04087

PROTOCOL FOR COLLECTING, PROCESSING, AND SHIPPING PRECIPITATION SAMPLES,
Geological Survey, Arvada, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04091

OPERATIONAL PROTOCOL FOR A RECORDING PRECIPITATION MONITOR,
Geological Survey, Arvada, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04092

SURFACE-RUNOFF MEASUREMENT AND SEDIMENT-SAMPLE-COLLECTION SYSTEM FOR SMALL AREAS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04097

ORGANOCHLORINE PESTICIDE AND PCB RESIDUES AT FOUR TROPHIC LEVELS IN THE SCHUYLKILL RIVER, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
J. L. Barker.
Available from Supt. of Docs, GPO, Washington, D. C. 20402. IN: USGS Water Supply Paper 2262, 1984. p 25-31, 1 fig, 10 tab, 14 ref.

Descriptors: *Pesticides, *Insecticides, *Chlorinated hydrocarbons, *Pesticide residues, *Path of pollutants, *Schuylkill River basin, *Pennsylvania, Public health, Pesticide kinetics, Polychlorinated biphenyls, Fish, Benthic fauna.

Various biological components within four trophic levels of the Schuylkill River in eastern Pennsylvania were examined for organochlorine pesticide and polychlorinated biphenyl residues (PCB's) in 1980. Components examined were periphyton, green algae, macrophytes, snails, and whole bodies and fillets of nine common fish species. Chlordane, dichlorodiphenyl trichloroethane (DDT) and its metabolites, dieldrin, and PCB's were detected at all trophic levels. Endrin and heptachlor epoxide were detected at all levels except primary consumers (snails). There is some evidence that these residues are being bioaccumulated in selected species at the higher trophic levels of the food web. The edible flesh of some fish such as American eel and sunfish, contain concentrations of chlordane and PCB's that exceed U.S. Food and Drug Administration guidelines. (USGS)
W89-04099

RECONNAISSANCE WATER QUALITY APPRAISAL OF THE FOUNTAIN CREEK ALLUVIAL AQUIFER BETWEEN COLORADO SPRINGS AND PUEBLO, COLORADO, INCLUDING TRACE ELEMENTS AND ORGANIC CONSTITUENTS,
Geological Survey, Denver, CO. Water Resources Div.
D. Cain, and P. Edelmann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 86-4085, 1986. 45p, 11 fig, 6 tab, 35 ref.

Descriptors: *Water quality, *Alluvial aquifers, *Colorado, *Surface groundwater relations, Trace elements, Hydrology, Organic compounds, Nitrogen compounds, Organic carbon, Colorado Springs, Pueblo.

This report describes the hydrology and chemical quality of water in the stream-aquifer system along Fountain Creek and relates groundwater quality to land use, water use, and wastewater discharges. The alluvial aquifer, which is underlain by shale bedrock, is transmissive, extensively pumped, and primarily is recharged by Fountain Creek and irrigation-return flow. Groundwater flows south about 20 ft/day, average residence time is less than 10 yr. Land use primarily is urban in the northern one-third and agricultural in the southern two-thirds of the area. Major ions, boron, iron, lithium, selenium, strontium, and uranium increased in concentration downgradient. The largest concentrations of nitrogen and detergents were in the northern end of the area because of recharge of sewage effluent in Fountain Creek. Other trace elements usually were present in concentrations less than 20 mg/L. Volatile organic compounds were detected in water from 11 of 20 wells sampled. Samples from 4 of the 20 wells were analyzed for semivolatile organics using a closed-loop stripping technique, which detected additional compounds at nanogram/L concentrations. (USGS)
W89-04104

AREAL AND TEMPORAL VARIABILITY OF WATER QUALITY OF THE SAN JUAN RIVER DRAINAGE BASIN UPSTREAM FROM SHIPROCK, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-04105

EFFECT OF REDUCED INDUSTRIAL PUMPAGE ON THE MIGRATION OF DISSOLVED NITROGEN IN AN OUTWASH AQUIFER AT OLEAN, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
M. P. Bergeron.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 85-4082, 1987. 38p, 7 fig, 7 tab, 21 ref, 14 pl.

Descriptors: *Groundwater pollution, *Nitrogen compounds, *Industrial wastes, *Path of pollutants, *New York, Pumping, Groundwater movement, Drawdown, Cattaraugus County, Allegheny River, Groundwater modeling.

A quasi-three-dimensional digital groundwater flow model of a shallow outwash aquifer system at Olean, New York, was developed to study the effects of several pumping alternatives on groundwater flow and stream seepage. Nitrogen compounds have contaminated the aquifer in an industrial park in North Olean. Pumping from seven

industrial production wells and a purge well has created a cone of depression within which all nitrogen compounds are contained, thus preventing their migration to nearby private, municipal, and industrial-supply wells. A simulated total shutdown of an industrial well field and the purge well indicates that groundwater flowing laterally southward to southwestward from the area of contamination would require about 5 yr to reach a municipal well field along the Allegheny River. Simulation of a partial shutdown with only three main production wells and the purge well or just the three production wells indicate that all nitrogen-bearing groundwater would be captured. Pumping from only the purge well would allow contaminated groundwater along the southwestern edge of the site to escape and, in 8 to 9 yr, reach the municipal well field. (USGS)
W89-04106

OVERVIEW OF SURFACE WATER QUALITY IN OHIO'S COAL REGION,
Geological Survey, Columbus, OH. Water Resources Div.
S. Westover, and M. Eberle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4061, 1987. 32p, 25 fig, 5 tab, 25 ref.

Descriptors: *Coal mining, *Land Reclamation, *Water quality, *Surface water, *Ohio, Land use, Coal mines, Statistical analysis, Iron, Sulfate, Specific conductivity, Hydrogen ion concentration, Aluminum, Alkalinity.

Statistical analysis of surface water quality data in coal mining areas from unmined, abandoned-mine, and reclaimed sites in Ohio showed that there were significant differences in stream flow pH, specific conductance, alkalinity, and concentrations of sulfate and aluminum between abandoned-mine and unmined sites. Streams at reclaimed sites had average pH values and aluminum concentrations similar to those in unmined sites. Average specific conductance and sulfate concentrations of stream water were about the same for reclaimed and abandoned-mine sites, but were significantly lower at unmined sites; specific conductance and sulfate concentration, in fact, proved to be reliable indicators of basins that had been disturbed by mining. Alkalinity in streams was significantly different for all three land uses, the highest values being found at reclaimed sites. (USGS)
W89-04113

ASSESSMENT OF LOW-FLOW WATER QUALITY IN RICHLAND CREEK, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
W. O. Freeman, and A. R. Schmidt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4323, 1986. 95p, 29 fig, 11 tab, 36 ref.

Descriptors: *Urban runoff, *Urbanization, *Water pollution sources, *Low flow, *Water quality data, *Computer models, *Water quality, *Illinois, Waste-assimilative capacity, Dissolved oxygen.

To study the effects of urbanization on water quality, the relations of several stream processes to concentrations of dissolved oxygen and other constituents were evaluated during low-flow periods for a 30.1-mi reach of Richland Creek in southwestern Illinois. The study used both measured data and computer simulations. Reaeration rates and traveltimes were measured at various flow rates using a steady-state, gas-tracer technique. Sediment-oxygen demands were measured at several locations throughout the study reach. Stream discharge, stage, temperature, and chemical-constituent concentrations were measured during two 24-hr periods in July and August 1984. The data were then used to describe water quality and to calibrate and verify the QUAL-II one-dimensional, steady-state, water quality model. (USGS)
W89-04117

HYDROLOGIC ANALYSIS OF TWO HEADWATER LAKE BASINS OF DIFFERING LAKE PH IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS OF NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
P. S. Murdoch, N. E. Peters, and R. M. Newton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4313, 1987. 49p, 17 fig, 5 tab, 36 ref.

Descriptors: *Acid rain, *Water pollution sources, *Path of pollutants, *Adirondack Mountains, *New York, Groundwater runoff, Evapotranspiration, Air pollution, Integrated Lake-Watershed Acidification Study, Water budget, Watershed hydrology, Base flow.

Hydrologic analysis of two headwater lake basins in the Adirondack Mountains, New York, during 1980-81 indicates that the degree of neutralization of acid precipitation is controlled by the groundwater contribution to the lake. According to flow-duration analyses, daily mean outflow/unit area from the neutral lake (Panther Lake, pH 5-7) was more sustained and contained a higher percentage of groundwater than that of the acidic lake (Woods Lake, pH 4-5). Outflow recession rates and maximum base-flow rates, derived from individual recession curves, were 3.9 times and 1.5 times greater, respectively, in the neutral-lake basin than in the acidic-lake basin. Groundwater contribution to lake outflow was also calculated from a lake-water budget; the groundwater contribution to the neutral lake was about 10 times greater than that to the acidic lake. Thick sandy till forms the groundwater reservoir and the major recharge area in both basins but covers 8.5 times more area in the neutral-lake basin than in the acidic-lake basin. More groundwater storage within the neutral basin provides longer contact time with neutralizing minerals and more groundwater discharge. As a result, the neutral lake has relatively high pH and alkalinity, and more net cation transport. (USGS)
W89-04119

QUALITY OF WATER IN MINES IN THE WESTERN MIDDLE COAL FIELD, ANTHRACITE REGION, EAST-CENTRAL PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
L. Reed, M. M. Beard, and D. J. Growitz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4038, 1987. 51p, 36 fig, 12 tab.

Descriptors: *Mine drainage, *Acid mine drainage, *Pennsylvania, *Water pollution sources, *Coal mines, Streamflow, Runoff, Anthracite.

The quality of mine water in the 75 sq-mi Western Middle anthracite field, Pennsylvania was determined by sampling discharges and boreholes at 60 abandoned and flooded mines during 1975-78. The Vulcan-Buck Mountain mine, east-northeast of Mahanoy City, contains an estimated 6,100 acre-ft of water with a specific conductance of 380 to 460 micromhos and a pH of 4.4 to 4.6 units. Twenty-two mines are in a 15-sq mi area between Mahanoy City and Girardville, all of which closed prior to 1958. Seven of these mines in the Mahanoy Basin may contain 30,000 acre-ft of water. Specific conductance ranges from 630 micromhos in the Tunnel mine to 1,800 micromhos in the Gilberton mine. Fifteen of these mines are in the Shenandoah complex; specific conductance ranges from 240 to 310 micromhos in mines in the eastern end of the complex to 2,400 micromhos in the western end. The specific conductance of water in 25 mines in the Mount Carmel-Shamokin area ranges from 460 to 980 micromhos. The North Franklin mine near Trevorton contains about 4,900 acre-ft of water with a specific conductance of about 1,100 micromhos. (USGS)
W89-04120

HYDROGEOLOGIC DATA FROM A STUDY OF THE FRESHWATER ZONE/SALINE WATER ZONE INTERFACE IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
D. Pavlicek, T. A. Small, and P. L. Rettman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-389, 1987. 108p, 5 fig, 7 tab, 15 ref.

Descriptors: *Saline-freshwater interfaces, *Texas, *Edwards aquifer, *Groundwater quality, *Saline water intrusion, Water quality data, Flow tests, Geophysical logs, Lithology.

A test-drilling program to assess the potential for saline water intrusion into the freshwater zone of the Edwards aquifer in the San Antonio region was undertaken from June 1985 through May 1986. This report presents hydrogeologic data collected during the drilling and initial testing of seven test holes located at three sites in San Antonio along the interface of the freshwater zone and saline water zone of the Edwards aquifer. Wells A-1, A-2, and A-3 (site A) are located in the saline water zone, wells C-1 and C-2 (site C) are considered to be transition zone locations, and wells D-1 and D-2 (site D) are considered to be freshwater zone locations. Wells were completed with screens or open intervals at several zones within the Edwards aquifer. Hydrogeologic data are presented for wells by site location. Information regarding flow tests, water quality, geophysical logs, and lithology are provided. Continuous water level recorders have been installed on each well to establish a record of water level fluctuations. Water samples for chemical analysis are being collected monthly to establish a record of variations in water quality. (USGS)
W89-04123

WATER LEVELS, CHLORIDE CONCENTRATIONS, AND PUMPAGE IN THE COASTAL AQUIFERS OF DELAWARE AND MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04126

SELECTED WATER QUALITY DATA FOR THE BURLEY IRRIGATION DISTRICT, SOUTH-CENTRAL IDAHO, MARCH-APRIL 1987,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04135

HYDROLOGIC DATA FOR SELECTED STREAMS IN THE COAL AREA OF SOUTHEASTERN OKLAHOMA, JULY 1978 TO SEPTEMBER 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04158

EVAPOTRANSPIRATION AND MICROCLIMATE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE IN NORTHWESTERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2D.
W89-04159

DESCRIPTION AND HYDROGEOLOGIC EVALUATION OF NINE HAZARDOUS-WASTE SITES IN KANSAS, 1984-86,
Geological Survey, Lawrence, KS. Water Resources Div.
R. J. Hart, and T. B. Spruill.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $12.00, microfiche $4.00. USGS Water Re-

sources Investigations Report 88-4015, 1988. 73p, 29 fig, 8 tab, 11 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Hazardous-waste sites, *Contamination, *Kansas, Air quality, Volatile organic compounds, Polynuclear aromatic hydrocarbons, Trace metals, Geohydrology.

Wastes generated at nine hazardous-waste sites in Kansas were disposed in open pits, 55-gal drums, or large storage tanks. These disposal methods have the potential to contaminate groundwater beneath the sites, the soil on the sites, and nearby surface water bodies. Various activities on the nine sites included production of diborane, transformer oil waste, production of soda ash, use of solvents for the manufacture of farm implements, reclamation of solvents and paints, oil-refinery wastes, meat packaging, and the manufacture and cleaning of tanker-truck tanks. Monitoring wells were installed upgradient and downgradient from the potential contamination source on each site. Strict decontamination procedures were followed to prevent cross contamination between well installations. Air-quality surveys were made on each site before other investigative procedures started. Hydrogeologic investigative techniques, such as terrain geophysical surveys, gamma-ray logs, and laboratory permeameter tests, were used. Groundwater level measurements provide data to determine the direction of flow. Groundwater contamination detected under the sites posed the greatest threat to the environment because of possible migration of contaminants by groundwater flow. Concentrations of volatile organic compounds, polynuclear aromatic hydrocarbons, and trace metals were detected in the groundwater at several of the sites. Many of the same compounds detected in the groundwater also were detected in soil and bedmaterial samples collected onsite or adjacent to the sites. Several contaminants were detected in background samples of groundwater and soil. (USGS)
W89-04171

USER'S MANUAL FOR ESTIMATION OF DISSOLVED-SOLIDS CONCENTRATIONS AND LOADS IN SURFACE WATER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-04172

TRAVELTIME, REAERATION, AND WATER QUALITY CHARACTERISTICS DURING LOW-FLOW CONDITIONS IN WILSONS CREEK AND THE JAMES RIVER NEAR SPRINGFIELD, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
W. R. Berkas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4074, 1987. 32p, 2 fig, 4 tab, 26 ref.

Descriptors: *Water quality, *Traveltime, *Path of pollutants, *Instream aeration, *Oxygen, *Reaeration, *Missouri, Dissolved oxygen, Ammonia, James River.

Before upgrading the Southwest Wastewater-Treatment Plant near Springfield, Missouri, to tertiary treatment, adverse water quality conditions resulting from discharge of wastewater effluent to Wilson Creek were documented in the creek and in the James River. About 7 years after the upgrading of the treatment plant, traveltime, reaeration, and water quality characteristics were determined in Wilsons Creek and the James River. Traveltime was measured once in Wilsons Creek and twice in the James River during low-flow conditions. Traveltimes in the James River were estimated for discharge between 55 and 200 cu ft/sec at a site near Boaz. Reaeration coefficients were calculated for five reaches in Wilsons Creek and the James River using the modified-tracer technique. Calculated reaeration coefficients were compared with coefficients predicted by twelve empirical equations and one equation was chosen that best fit the data. Water quality data were collected during two 44-hr periods, August 14 to 16, 1984, and July 23 to 25, 1985. Samples were collected at the outflow of the Southwest Wastewater Treatment Plant at seven sites along Wilsons Creek and the James River. Dissolved-oxygen concentrations in Wilsons Creek and the James River were all larger than Missouri's water quality standard of 5.0 mg/l. Ammonia concentrations and 5-day carbonaceous biochemical oxygen demands were small, which indicated that the oxygen consumption by oxidizing ammonia and carbonaceous organic materials would be insignificant. Measured streambed oxygen demand in the James River was largest directly downstream from Wilsons Creek. (USGS)
W89-04175

WATER QUALITY ASSESSMENT OF PERUQUE CREEK, ST. CHARLES COUNTY, MISSOURI, JULY 1983 AND JULY 1984,
Geological Survey, Rolla, MO. Water Resources Div.
W. R. Berkas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4079, 1987. 45p, 9 fig, 8 tab, 29 ref.

Descriptors: *Missouri, *Peruque Creek, *Wastewater treatment, *Oxygen demand, *Waste-assimilative capacity, *Path of pollutants, *Water quality, *Simulation analysis, Computers, Dissolved oxygen, Ammonia.

Physical, chemical, and biological data collected along the downstream 24.1-river-mi reach of Peruque Creek, Missouri, on July 18-19, 1983 and July 9-10, 1984, were used to characterize the water quality conditions in the creek. Wastewater discharges into the creek at the Lake St. Louis sewage-disposal ponds and at the O'Fallon wastewater-treatment facility. The effluent from the sewage disposal ponds did not have a substantial effect on downstream water quality but that from the wastewater treatment facility caused the Missouri un-ionized ammonia standard of 0.1 mg/l as nitrogen to be exceeded downstream from the outflow. Discharge from the O'Fallon facility also caused all dissolved-oxygen concentrations measured downstream from the outflow to be less than the Missouri dissolved-oxygen standard of 5.0 mg/L. Attempts were made to calibrate and verify the QUAL-II/SEMCOG version water quality model. The model could not be adequately calibrated or verified, because of the non-uniform hydraulic conditions in Peruque Creek, which is characterized by slow velocities; long, deep pools; and inadequate mixing characteristics; and also the non-uniform quantity and quality of effluent discharged from the O'Fallon wastewater treatment facility. Thus, the assumptions of one-dimensional flow and steady-state conditions necessary for the model were not valid. The attempt to calibrate and verify the model indicated that during low-flow conditions the waste-load assimilative capacity of the downstream 17.9 river miles of Peruque Creek was limited. (USGS)
W89-04176

TRAVELTIME AND DISPERSION IN THE ILLINOIS RIVER, MARSEILLES TO PEORIA,
Geological Survey, Urbana, IL. Water Resources Div.
E. E. Zuehls.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4106, 1987. 29p, 11 fig, 9 tab.

Descriptors: *Dispersion, *Path of pollutants, *Tracers, *Dye dispersion, *Illinois, Illinois River, Traveltime, Water pollutants, Streamflow, Flood duration, Dye concentration.

Traveltime in 89.3 mi of the Illinois River between Marseilles Dam and Peoria Dam was measured using rhodamine-WT dye. On each of four subreaches, dye-tracer measurements were made at approximately 50- and 85% flow duration in 1978, 1979, and 1985. The dye-tracer data were used to develop a method for estimating the traveltime and peak concentration of a solute spilled into the Illinois River. The estimates can apply to spills at any point within the study reach during a period of relatively steady discharge of from low to medium streamflow. A sample problem to demonstrate the estimating method is solved for a hypothetical situation in which 100,000 pounds of contaminant is spilled at a railroad crossing between Spring Valley and Hennepin, Illinois. (USGS)
W89-04177

GEOHYDROLOGIC CONDITIONS AT THE NUCLEAR FUEL REPROCESSING PLANT AND WASTE-MANAGEMENT FACILITIES AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
M. P. Bergeron, W. M. Kappel, and R. M. Yager.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4145, 1987. 49p, 22 fig, 1 pl, 8 ref.

Descriptors: *Radioactive wastes, *Fuel reprocessing, *Radioactive waste disposal, *Geohydrology, *New York, *Groundwater movement, Hydrology, Groundwater, Cattaraugus County, Western New York Nuclear Service Center, West Valley, Path of pollutants.

A nuclear-fuel reprocessing plant, a high-level radioactive liquid-waste tank complex, and related waste facilities occupy 100 hectares (ha) within the Western New York Nuclear Service Center near West Valley, N.Y. The facilities are underlain by glacial and postglacial deposits that fill an ancestrial bedrock valley. The main plant facilities are on an elevated plateau referred to as the north plateau. Groundwater on the north plateau moves laterally within a surficial sand and gravel from the main plant building to areas northeast, east, and southeast of the facilities. The sand and gravel ranges from 1 to 10 m thick and has a hydraulic conductivity ranging from 0.1 to 7.9 m/day. Two separate burial grounds, a 4-ha area for low-level radioactive waste disposal and a 2.9-ha area for disposal of higher-level waste are excavated into a clay-rich till that ranges from 22 to 28 m thick. Migration of an organic solvent from the area of higher level waste at shallow depth in the till suggests that a shallow, fractured, oxidized, and weathered till is a significant pathway for lateral movement of groundwater. Below this zone, groundwater moves vertically downward through the till to recharge a lacustrine silt and fine sand. Within the saturated parts of the lacustrine unit, groundwater moves laterally to the northeast toward Buttermilk Creek. Hydraulic conductivity of the till, based on field and laboratory analyses, ranges from 0.000018 to 0.000086 m/day. (USGS)
W89-04178

WATER QUALITY OF FREMONT LAKE AND NEW FORK LAKES, WESTERN WYOMING - A PROGRESS REPORT,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson, R. C. Averett, and K. L. Mora.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4016, 1987. 55p, 33 fig, 9 tab, 32 ref.

Descriptors: *Acid rain, *Limnology, *Lakes, *Wyoming, Organic acids, Inorganic acids, Nutrients, Benthos, Plankton, Fremont Lake, New Fork Lakes, Sublette County.

Fremont Lake and New Fork Lakes in the New Fork River drainage of western Wyoming were selected for a comprehensive study of hydrologic processes affecting mountain lakes in the Rocky Mountains. Information is needed about lakes in this area to assess their response to existing and planned development. The concerns include regional issues such as acid precipitation from gas-sweetening plants, coal-fired powerplants, and smelters, as well as local issues, such as shoreline development and raising outlet control structures.

Onsite measurements indicated strong thermal stratification in the lakes during the summer. Isothermal conditions occurred during December 1983 and May 1984. Mean phytoplankton concentrations were less than 5,000 cells/ml, and chlorophyll a concentrations were weakly correlated with phytoplankton concentrations. Zooplankton concentrations were small, less than 6 organisms/L. The numbers of benthic invertebrates/unit area in Fremont Lake were extremely small. The lake waters and inflow and outflow streams were chemically dilute solutions. Mean dissolved-solids concentrations were 13 mg/L in Fremont Lake and 24 mg/L in New Fork Lakes. Calcium and bicarbonate were the predominant ions. Concentrations of phosphorus and nitrogen usually were less than detection limits. Trace-metals concentrations in the lakes were similar to those in precipitation and generally were small. Dissolved organic-carbon concentrations were about 1 mg/L. Concentrations of fulvic and humic acids were relatively large in the inlet of Fremont Lake during the spring. Pine Creek has deposited 800 metric tons of sediment, on an annual average, to the delta of Fremont Lake. Most sediment is deposited during spring runoff. (USGS)
W89-04180

CALCULATION OF THE NEAR FIELD OF VELOCITIES AND TEMPERATURES BEYOND A SURFACE DISCHARGE OF HEATED WATER,
For primary bibliographic entry see Field 8B.
W89-04197

LONG-TERM LEAKAGE OF NITRATE FROM BARE UNMANURED SOIL,
Rothamsted Experimental Station, Harpenden (England).
T. M. Addiscott.
Soil Use and Management, Vol. 4, No. 3, p 91-95, September 1988. 1 fig, 3 tab, 16 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Fertilizers, *Nitrates, *Drainage water, Long-term studies, Soil chemistry, England, Rainfall, Curve fitting, Prediction.

The Rothamsted (England) Drain Gauges, built in 1870, comprise blocks of soil, 0.5, 1.0, and 1.5 m deep, isolated laterally by brickwork and undermined for the collection of drainage water, but otherwise undisturbed. The soil has not been cropped, manured, or cultivated subsequently. The annual nitrate leakages from these blocks were recorded for the 38 yr from 1877/8 to 1914/5. The soil in the 0.5- and 1.5-m gauges lost on average about 45 kg/ha of nitrate-N per year during the first 7 years of this period. That in the 1.0-m gauge lost slightly less. The overall decline in leakage was masked by large annual fluctuations attributable mainly to variation in rainfall. Fitting a simple function that assumed an exponential decline and took account of rainfall fluctuations gave a rate constant for each gauge from which the half-life could be estimated for the organic nitrogen feeding the leakage. The half-life for the 1.5-m gauge was 41 years. The average nitrate leakage during the first 7 years of the record differs little from estimates of the current leakage from soil carrying fully fertilized crops of winter wheat. This and the long half-life of the leakage show that pollution of drainage water by nitrate will not be controlled by limiting the use of fertilizer in the short term. (Author's abstract)
W89-04212

PHOSPHORUS TRANSPORT MODEL FOR SMALL AGRICULTURAL WATERSHEDS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
A. Rousseau, W. T. Dickinson, R. P. Rudra, and G. J. Wall.
Canadian Agricultural Engineering CAEOAI, Vol. 30, No. 2, p 213-220, July 1988. 8 fig, 2 tab, 26 ref.

Descriptors: *Phosphorus losses, *GAMESP Model, *Agricultural watersheds, *Water pollution sources, *Nonpoint pollution sources, *Computer programs, *Erosion, *Sediment transport, Path of pollutants, Mapping, Model studies, Calibration studies, Performance evaluation, Slopes, Grain crops.

GAMESP, the Guelph model for evaluating the effects of Agricultural Management on Erosion, Sedimentation, and Phosphorus yields, is proposed to delineate source areas of sediment and phosphorus delivery to surface waters of small agricultural watersheds. The concepts and components of the model are presented, the computational approach is described, and an application of the model on a small agricultural watershed (Stratford/Avon Demonstration Watershed) in southern Ontario is described. The model consists of two major components: the potential soil loss/sedimentation component and the phosphorus component. GAMESP is easy to use and cost effective (designed for IBM PC-type microcomputers), making use of limited amounts of readily available input data and easily quantifiable physical and hydrological characteristics of the watershed. Calibration of the GAMESP model on the Stratford/Avon Demonstration Watershed provided a delineation and mapping of the source areas of sediment and phosphorus yields (attributable to sheet and rill erosion) for the 1983 spring season. Most of the watershed phosphorus yield was transported across a small percentage of the watershed area, because most of the phosphorus originated from steeply-sloped corn and grain fields located near the drainage channel. Relatively steeply-sloped corn and grain fields remote from good drainage channels exhibited serious local erosion problems but contributed little or no sediment or phosphorus yield to the stream. For the 1983 spring season, the average cell-to-stream P-enrichment ratio for the watershed was 2.4. (Rochester-PTT)
W89-04217

EFFECT OF ACID RAIN ON PROPERTIES OF MOUNTAIN BROWN FOREST SOILS,
Akademiya Nauk SSSR, Vladivostok. Inst. of Pacific Ocean Geography.
P. V. Yelpatyevskiy, and V. S. Arzhanova.
Soviet Soil Science SSSCAE, Vol. 20, No. 1, p 105-116, January-February 1988. 2 fig, 2 tab, 17 ref. Translated from Pochvovedeniye, No. 8:75-86, 1987.

Descriptors: *Acid rain effects, *Acidic soils, *Soil chemistry, *Forest soils, *Water pollution sources, *Soil water, Brown forest soil, Humus-alluvial soil, Fulvic acids, Sikhote-Alin, Weathering, Iron, Aluminum, Calcium, Carbon, Lysimeters.

An interdisciplinary geochemical research study on ecosystems of the oak forest belt of the long eastern slope of the Central Sikhote-Alin found the effect of acid rain on humus-Alluvial Brown Forest soils is not reflected in the total chemical composition of the soil, but it does increase the fulvic acids, accelerates humus alluviation, increases the acidity of soils and soil solutions, accelerates the removal of carbon by the soil water, enlarges the role of low-molecular water-soluble organic compounds, and intensifies recent weathering within the soil and the removal of dissolved Al, Fe, and Ca. The chemical composition of lysimeter solutions provides more complete information than the soil solid phase about the processes induced in soil by man and reveals the first signs of artificial transformation of the soil. (White-Reimer-PTT)
W89-04282

DIVERGENCE AND ENTRAINMENT IN A RIVER EFFLUENT: THE HEARTBREAK MODEL,
Kyoto Univ. (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 2L.
W89-04296

RESIDUES OF DETERGENT-DERIVED ORGANIC POLLUTANTS AND POLYCHLORINATED BIPHENYLS IN SLUDGE-AMENDED SOIL,
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 5E.
W89-04297

USE OF WEATHER RADAR IN ASSESSING DEPOSITION OF RADIOACTIVITY FROM CHERNOBYL ACROSS ENGLAND AND WALES,
Imperial Coll. of Science and Technology, London (England). Air Pollution Group.
H. M. ApSimon, K. L. Simms, and C. G. Collier.
Atmospheric Environment ATENBP, Vol. 22, No. 9, p 1895-1900, September 1988. 10 fig, 8 ref.

Descriptors: *Water pollution sources, *Radar, *Precipitation scavenging, *Nuclear explosions, *Radioactivity, *Chernobyl, England, Wales, Weather data collections, Nuclear reactors.

Deposition of radionuclides from the Chernobyl accident depended critically on patterns of precipitation intercepting the material. The use of the RAINPATCH model to calculate wet deposition of Cs 137 over England and Wales is described. This puff-based model makes direct use of precipitation data measured by weather radar to determine the scavenging of airborne material. The detailed spatial and temporal resolution of when and where material was scavenged provides good agreement with measurements. Since all the data used could potentially have been available at the time, such methods could usefully be applied in real time in the event of any future accident releasing such radionuclides. (Author's abstract)
W89-04298

CHEMICAL COMPOSITION OF ATMOSPHERIC PRECIPITATION IN CZECHOSLOVAKIA, 1978-1984-II EVENT SAMPLES,
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
B. Moldan, J. Kopacek, and J. Kopacek.
Atmospheric Environment ATENBP, Vol. 22, No. 9, p 1901-1908, September 1988. 1 fig, 8 tab, 24 ref.

Descriptors: *Acid rain, *Precipitation, *Chemistry of precipitation, *Rainfall, *Meteorological data collection, *Water pollution sources, Bohemia, Czechoslovakia, Meteorology.

Precipitation events were sampled for 5 yr during the period 1978-1982 at station Hradek u Pacova, Central Bohemia. In 483 samples (95% of the events larger than 1 mm) pH and electrical conductivity were measured; 206 samples were analyzed for 12 major components. The influence on chemical composition of six kinds of meteorological parameters was evaluated: origin of air masses, type of atmospheric fronts, large-scale weather situations, velocity of the advance of precipitation areas, precipitation amount, velocity and direction of air flow. Different types of weather situations influenced the chemical composition of precipitation. However, relatively high values of standard deviation acknowledge that each individual meteorological situation is in a certain degree unique and the chemical composition of the precipitation water corresponds to this fact. (White-Reimer-PTT)
W89-04299

MONTHLY HYDROGEN ION DEPOSITION MAPS FOR THE NORTHEASTERN U.S. FROM JULY 1982 TO SEPTEMBER 1984,
Consolidation Coal Co., Pittsburgh, PA.
R. A. Bilonick.
Atmospheric Environment ATENBP, Vol. 22, No. 9, p 1909-1924, September 1988. 11 fig, 5 tab, 18 ref.

Descriptors: *Statistical analysis, *Water pollution sources, *Kriging, *Precipitation, *Acid rain, Indicator kriging, Risk qualified maps, Space-time data analysis, Hydrogen ion deposition, Northeastern U.S.

Data collected in the northeastern U.S. by the National Coal Association Precipitation Quality Network and analyzed by BCR National Laboratory were used to construct comprehensive maps of H(+) deposition using indicator kriging. Com-

prehensive space-time indicator semi-variogram analysis showed that the correlation between observations decreases as the level of deposition increases. Indicator kriging produced an estimate of the local probability distribution function of H(+) deposition at each grid point for each month from July 1982-September 1984. In addition, probability intervals derived from the estimated local probability distribution functions for various points in the northeastern U.S. and at various times show the likely change in H(+) deposition over time and location. These intervals were used to characterize the reliability of point estimates of deposition, and reflected network configuration and the local variability of the data spatially and temporally near the point to be estimated. (Author's abstract)
W89-04300

USE OF KRIGING IN THE SPATIAL ANALYSIS OF ACID PRECIPITATION DATA,
ERT, Inc., Camarillo, CA.
For primary bibliographic entry see Field 7C.
W89-04301

ASSESSING STRATEGIES FOR CONTROL OF IRRIGATION-INDUCED SALINITY IN THE UPPER COLORADO RIVER BASIN,
For primary bibliographic entry see Field 5G.
W89-04302

TROPHIC INTERACTIONS IN THE HYPERTROPHIC LAKE TJEUKEMEER: TOP-DOWN AND BOTTOM-UP EFFECTS IN RELATION TO HYDROLOGY, PREDATION AND BIOTURBATION DURING THE PERIOD 1974--1985,
Limnologisch Inst., Oosterzee (Netherlands).
For primary bibliographic entry see Field 5G.
W89-04309

SURVEY OF VIRAL POLLUTION IN DUERO RIVER (SPAIN): OCCURRENCE OF NATURAL VIRUCIDAL PHENOMENA,
Valladolid Univ. (Spain).
R. M. Arribas, A. Bosch, F. Lucena, and R. Pares.
Environment International ENVIDV, Vol. 14, No. 1, p 37-41, 1988. 1 fig, 4 tab, 14 ref.

Descriptors: *Water pollution sources, *Wastewater outfall, *Enteroviruses, *Aerobic bacteria, *Streptococcus, Duero River, Spain, Human diseases, Viral pollution, Coliforms, Viruses.

A 17-month survey was undertaken to monitor the occurrence of enteroviruses at five sampling stations along the Duero River, in the vicinity of Soria, Spain. Total aerobic bacteria, total and fecal coliforms, and fecal streptococci, together with several physiochemical parameters were also analyzed. Although all the bacterial populations under study correlated to each other, no correlation was demonstrated between virus levels and any other parameter. This lack of correlation between viruses and bacteria may be caused by the different decay rates shown by bacteria and viruses, although methodological limitations cannot be ruled out. The data clearly show the need for routine virological analysis to ascertain the viral pollution level of a water sample. The occurrence of virus depuration processes was verified. The river acquires a high level of fecal contamination after the discharge of a heavily contaminated urban sewage outfall. A progressive decrease in virus levels was observed along the river course, showing the effectivness of natural virus inactivation phenomena occurring in the river. The heavy use of these waters for drinking, agricultural, or recreational purposes calls for a thorough understanding of the presence and behavior of pathogenic viruses in this environment. (Davis-PTT)
W89-04317

PATTERNS OF CHERNOBYL FALLOUT IN RELATION TO LOCAL WEATHER CONDITIONS,
Goeteborg Univ. (Sweden). Dept. of Radiation Physics.
S. Mattsson, and R. Vesanen.
Environment International ENVIDV, Vol. 14, No. 2, p 177-180, 1988. 4 fig, 1 tab, 5 ref.

Descriptors: *Water pollution sources, *Fallout, *Chernobyl, *Radionuclides, Chemistry of precipitation, Precipitation, Goteborg, Rainfall, Sweden.

The deposition of a number of radionuclides from the Chernobyl accident was measured in Goteborg in western Sweden. Only about 1% of the dominating radionuclides 134,137Cs, 131I, and 103,106Ru which finally reached the ground was deposited in dry form, mainly during the period April 27-May 8, 1986. The rest, 99%, was deposited during one single period of rain on May 8, 1986. The activity concentration in the rainwater decreased by a factor of about 50 from beginning to end of this 12 hour period showing the most pronounced decrease during the first two hours. Compared with the period of dry deposition, the relative amounts of 141,144Ce, 95Zr, and 140Ba deposited during the rain on May 8 were low. (Author's abstract)
W89-04319

DISTRIBUTION AND FORMATION OF HIGH-FLUORINE GROUNDWATER IN CHINA,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2K.
W89-04321

SIMULATION OF THE AQUATIC FATE OF TRICLOPYR BUTOXYETHYL ESTER AND ITS PREDICTED EFFECTS ON COHO SALMON,
Dow Chemical Co., Midland, MI. Agricultural Products Dept.
P. J. McCall, D. A. Laskowski, H. D. Bidlack, and M. J. Mac.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 517-527, July 1988. 7 fig, 6 tab, 14 ref.

Descriptors: *Herbicides, *Pesticides, *Model studies, *Fate of pollutants, *Salmon, Triclopyr butoxyethyl ester, Ponds, Population exposure, Toxicity.

Mathematical simulations of the dissipation of triclopyr butoxyethyl ester in a model aquatic system representing a shallow, static pond were conducted. Aqueous hydrolysis, sorption to bottom sediment, hydrolysis in sediment and photolysis were considered in predicting aqueous concentration-time profiles. Potential concentrations in Coho salmon were evaluated as part of the model based on rate constants for uptake, hydrolysis and elimination as determined in laboratory investigations conducted in other studies. Predicted chemical concentrations in the fish were then related to toxicity data to estimate aqueous concentrations in the model environment required to give a toxic response. In general, the simulations showed that the ester concentration in the pond water would decline, with an approximate half-life of 6 to 24 hours. Initial ester concentrations of 1.0 to 1.5 mg/L in this simulated pond environment would be required to result in chemical concentrations in fish above toxic threshold levels. (Author's abstract)
W89-04326

CHEMICAL CHARACTERIZATION AND MUTAGENIC PROPERTIES OF POLYCYCLIC AROMATIC COMPOUNDS IN SEDIMENT FROM TRIBUTARIES OF THE GREAT LAKES,
National Fisheries Contaminant Research Center, Columbia, MO.
D. L. Fabacher, C. J. Schmitt, J. M. Besser, and M. J. Mac.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 529-543, July 1988. 2 fig, 8 tab, 51 ref.

Descriptors: *Lake sediments, *Pollutants, *Water pollution effects, *Mutagenesis, Chemical composition, Great Lakes, Sediments, Aromatic compounds, Gas chromatography, Mass spectrometry, Chemical analysis.

Sediments from four inshore industrial sites and a reference site in the Great Lakes were extracted with solvent and characterized chemically for polycyclic aromatic compounds (PACs). An aqueous phase and a crude organic extract were obtained. The crude organic extract was further resolved into fractions A-2 (polycyclic aromatic hydrocarbons) and A-3 (nitrogen containing polycyclic aromatic compounds), which were analyzed for PACs by gas chromatography and gas chromatography-mass spectrometry. The extracts and fractions were tested for mutagenicity in three assays: Ames, rat hepatocyte unscheduled DNA synthesis, and Chinese hamster ovary hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT). Sediments from the industrial sites contained 27 to 363 micrograms/g total PACs; the reference site, less than 1 microgram/g. Qualitative differences in the residue profiles among the sites were attributable to the probable sources of the PACs (petroleum versus combustion). Only one industrial site yielded measurable (0.1 microgram/g or more) concentrations of individual nitrogen-containing PACs. In the Ames assay, only the highest doses of the A-2 fractions from two sites approached positive results. The crude organic extract and A-2 and A-3 fractions from all sites induced unscheduled DNA synthesis. Crude organic extracts and the A-2 and A-3 fractions from all industrial sites gave well-defined dose-response relations in the CHO/HGPRT assay. The presence of chemical mutagens in sediment that could be correlated with neoplasms in fish from many of the sites was established; however, the mutagenicity of the sediment extracts was not completely related to the degree of contamination by PACs. (Author's abstract)
W89-04327

MODELING BIOCONCENTRATION OF NONPOLAR ORGANIC POLLUTANTS BY FISH,
Environmental Research Lab., Athens, GA.
M. C. Barber, L. A. Suarez, and R. R. Lassiter.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 545-558, July 1988. 2 fig, 3 tab, 100 ref, append.

Descriptors: *Path of pollutants, *Model studies, *Tissue analysis, *Fish, *Biological magnification, Diffusion, Organic compounds, Lipids.

A model describing thermodynamically driven kinetic exchange of organic chemicals between fish and the aqueous environment was developed. This model considers both the biological attributes of the fish and the physicochemical properties of the chemical that determine diffusive exchange across gill membranes. Important biological characteristics addressed by the model are the fish's gill morphometry, body weight and fractional aqueous, lipid and structural organic composition. Relevant physicochemical properties are the chemical's aqueous diffusivity, molar volume and n-octanol/water partition coefficient, which is used as a surrogate to quantify chemical partitioning to the fish's lipid and structural organic fractions. Using this model, excretion rates, gill uptake efficiencies and bioconcentration factors can be predicted for nonmetabolized organic chemicals. (Author's abstract)
W89-04328

ACUTE TOXICITY OF THIOCYANATE AND CYANATE TO RAINBOW TROUT AS MODIFIED BY WATER TEMPERATURE AND PH,
Noranda Research Centre, Pointe Claire (Quebec).
M. R. Speyer, and P. Raymond.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 565-571, July 1988. 4 fig, 3 tab, 14 ref.

Descriptors: *Temperature effects, *Trout, *Hydrogen ion concentration, *Water pollution effects, *Bioassay, *Toxicity, *Cyanate, Fish, Thiocyanate.

Acute 96-hour static bioassays were conducted with juvenile rainbow trout (Salmo gairdneri) to assess the toxicity of thiocyanate (CNS) and cyanate (CNO), as potassium salts, under several pH and temperature regimes. Bioassays were conduct-

ed at pH 6 or 8 and at temperatures of 5 or 12 C. Mean 96-hour LC50 values for CNS ranged between 177 and 264 mg/L, and for CNO, between 15 and 81 mg/L, depending on test conditions. The data suggested that pH influenced the toxicity of both CNS and CNO more than did temperature. Stressing of fish at the end of each bioassay resulted in almost instantaneous mortalities in most CNS-exposed fish, but no stress effects were observed in CNO-exposed fish. There were indications that water hardness reduced CNS and CNO toxicity. (Author's abstract)
W89-04329

BIODEGRADATION OF NTA AND M-CRESOL IN COASTAL ENVIRONMENTS,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
A. V. Palumbo, F. K. Pfaender, and H. W. Paerl.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 573-585, July 1988. 6 fig, 4 tab, 23 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *m-Cresol, *Estuarine environment, *Rivers, *Nitrilotriacetic acid, *Coastal waters, Bacteria, Mississippi River, North Carolina, Temperature effects, Radioactive tracers, Seasonal variation.

The biodegradation of m-cresol and nitrilotriacetic acid (NTA) by nonadapted natural populations of aerobic heterotrophic bacteria was examined in a coastal environment near Beaufort, North Carolina, over an 18-month period and in synoptic samples from the Mississippi River, its plume and adjacent coastal waters. The uptake kinetics of radiolabeled m-cresol and NTA were measured at a freshwater site, an estuarine site and a high-salinity offshore site. Uptake of both compounds was greatest in the summer, and half-saturation constants and maximum uptake velocities were greater for NTA than for m-cresol. m-Cresol uptake was greatest in the freshwater environment, and NTA uptake was greatest in the estuary where bacterial numbers and activity were also highest. The uptake of both compounds was lowest in the offshore environment where biological activity was lowest. It appears from the spatial patterns in the Newport River estuary and in areas off the Mississippi that m-cresol biodegradation is substantially reduced at increasing salinity but that NTA uptake is not. Only at extremely low concentrations (less than 1 to 10 microgram/liter) and only during the warmer portions of the year is biodegradation of m-cresol in freshwater and estuarine environments important in determining its fate. At higher concentrations and in the marine environment, biodegradation by nonadapted populations is slow and other processes, such as adaptation, dilution and mixing, may be more significant in determining the fate of both compounds. (Author's abstract)
W89-04330

DISSOLVED ORGANIC MACROMOLECULES REDUCE THE UPTAKE OF HYDROPHOBIC ORGANIC CONTAMINANTS BY THE GILLS OF RAINBOW TROUT (SALMO GAIRDNERI),
Oak Ridge National Lab., TN. Environmental Sciences Div.
M. C. Black, and J. F. McCarthy.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 7, p 593-600, July 1988. 3 fig, 1 tab, 28 ref.

Descriptors: *Path of pollutants, *Trout, *Bioaccumulation, *Benzo(a)pyrene, *Polychlorinated biphenyls, Absorption, Adsorption, Organic compounds, Humic acids, 2,2',5,5'-Tetrachlorobiphenyl.

The effect of the binding of two model hydrophobic organic contaminants, benzo(a)pyrene and 2,2',5,5'-tetrachlorobiphenyl, to Aldrich humic acid, a commercially available source of dissolved organic macromolecules (DOM), on the uptake of these contaminants by the gills of rainbow trout (Salmo gairdneri) was examined. The efficiency with which trout gills extracted the contaminants from water (with and without DOM present) was measured using a fish metabolic chamber that separated exposure water from water that passed over the gills. Measurements of the contaminant extraction efficiency of trout gills were compared with measurements of contaminant binding to DOM. Contaminants bound to DOM did not diffuse across the gill membrane. Percentage reductions in the concentration of freely dissolved contaminant were equal to percentage reductions in the uptake of the contaminant by the gills. Thus, only the freely dissolved contaminant appears to be available for uptake by fish gills. These correlations between the concentration of freely dissolved contaminant and the fraction of the exposure concentration that is transferred across the gills provide a basis for predicting contaminant dose based on physicochemical measurements of contaminant binding to naturally occurring DOM in the aquatic environment. (Author's abstract)
W89-04331

CHARACTERIZATION OF AGRICULTURAL NONPOINT POLLUTION: NUTRIENT LOSS AND EROSION IN A WEST TENNESSEE WATERSHED,
Memphis State Univ., TN. Dept. of Biology.
S. J. Klaine, M. L. Hinman, D. A. Winkelmann, J. R. Martin, and K. R. Sauser.
Environmental Toxicology and Chemistry ETOCDK, 601-607, August 1988. 2 fig, 5 tab, 17 ref.

Descriptors: *Water pollution sources, *Agricultural chemicals, *Nonpoint pollution sources, *Nutrients, Nitrogen, Phosphorus, Soil erosion, Storms, Tennessee, Storm runoff.

Research was conducted on an 18-ha, bermed, single-field watershed in west Tennessee to characterize soil and nutrient losses during storm events over a 12-month period. Total soil loss was approximately 104 metric tons, which is high for the nation but typical for west Tennessee. Minimums of 2% of applied phosphorus and 6% of applied nitrogen were lost from the field through storm water runoff. First-flush analysis indicated that total suspended solids, orthophosphate, ammonia, and total Kjeldahl nitrogen migrated from the field faster than if proportional to the flow. In general, orthophosphate came off the field early in the runoff event, whereas other forms of phosphorus came off late in the event. (Author's abstract)
W89-04332

CHARACTERIZATION OF AGRICULTURAL NONPOINT POLLUTION: PESTICIDE MIGRATION IN A WEST TENNESSEE WATERSHED,
Memphis State Univ., TN. Dept. of Biology.
S. J. Klaine, M. L. Hinman, D. A. Winkelmann, K. R. Sauser, and J. R. Martin.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 8, p 609-614, August 1988. 3 fig, 3 tab, 21 ref.

Descriptors: *Water pollution sources, *Pesticides, *Agricultural runoff, *Storm, *Nonpoint pollution sources, Tennessee, Atrazine, Percolation, Rainstorms, runoff.

Pesticide migration from agricultural fields may stress receiving stream ecosystems as well as contaminate ground water. Research was conducted on an 18-ha single field watershed in west Tennessee to characterize the fate of atrazine during a 12-month period after pesticide application. Rainfall runoff and soil cores were sampled and analyzed for atrazine residues. Total loss of atrazine by runoff accounted for approximately 1.5% of the total atrazine applied. Concentrations as high as 0.25 mg/L were detected in the field discharge. By the fourth storm event after pesticide application, the atrazine concentration was below detection limits (0.1 micrograms/L). Atrazine loss in the upper 10 cm of soil followed a first-order decay trend, with only 1.88% of the initial concentration remaining 238 days after pesticide application. The mean half life for atrazine in the upper 10 cm was approximately 21.5 days. Atrazine was detected in the 10 to 20-cm soil level after the first rainfall. Atrazine was not detected below 20 cm at any sampling date during the 238 days of the study. (Author's abstract)
W89-04333

SCREENING AND BIOMONITORING OF INDUSTRIAL EFFLUENTS USING PHYTOTOXICITY TESTS,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5A.
W89-04334

EFFECTS OF CHLORINE ON MICROBIAL COMMUNITIES IN NATURALLY DERIVED MICROCOSMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W89-04335

PHOTOOXIDATION PRODUCTS OF SMOKE GENERATOR FUEL (SGF) NO. 2 FOG OIL AND TOXICITY TO HYALLELA AZTECA,
Battelle Pacific Northwest Labs., Richland, WA.
T. M. Poston, R. M. Bean, D. R. Kalkwarf, B. L. Thomas, and M. L. Clark.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9, p 753-762, September 1988. 5 fig, 4 tab, 19 ref.

Descriptors: *Toxicity, *Amphipods, *Water pollution effects, *Fog oil, Oxidation, Gas chromatography.

Photooxidation of smoke generator fuel (SGF) No. 2 fog oil was investigated to determine qualitative changes in the chemistry of the oil and the resulting acute toxicity to the freshwater amphipod Hyallela azteca. The 48-hour LC50 was about 11.5 mg total oil/L for photooxidized fog oil. Toxicity was related to the greater solubility of photooxidized fog oil in that higher concentrations of total dissolved oil in oil-water mixtures were obtained after equivalent additions of photooxidized oil and nonphotooxidized oil. Photooxidation caused increases in carbonyl oxygen and the presence of alpha- and beta-unsaturated ketones and acetophenones in aqueous extracts. There was no evidence for the formation of phenolic compounds in the photooxidized fog oil or in oil-water mixtures. (Author's abstract)
W89-04341

NONEQUILIBRIUM SORPTION OF ORGANIC CONTAMINANTS DURING FLOW THROUGH COLUMNS OF AQUIFER MATERIALS,
Florida Univ., Gainesville. Dept. of Soil Science.
L. S. Lee, P. S. C. Rao, M. L. Brusseau, and R. A. Ogwada.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 779-793, October 1988. 6 fig, 4 tab, 47 ref.

Descriptors: *Path of pollutants, *Aquifers, *Sorption, *Groundwater pollution, *Trichloroethylene, *Xylene, Kinetics, Model studies, Organochlorines.

Batch equilibrium and miscible displacement studies were conducted to investigate sorption and transport of trichloroethylene (TCE) and p-xylene in two sand aquifer materials low in organic carbon content. The utility of a bicontinuum (two-site) sorption model to describe the extent of sorption nonequilibrium during transport in saturated columns was evaluated. Model parameters estimated from the breakthrough curves (BTC) obtained at a high pore water velocity (v = 24 cm/h) were used successfully to describe the BTC measured at a lower pore water velocity (v = 6 cm/h). The assumption of local sorption equilibrium was valid at the lower velocity, and the measured BTC could be described by an equilibrium sorption model coupled to a convective-dispersive transport model. Values for column retardation factors estimated by fitting the two-site model to the BTC were comparable with those estimated from equilibrium sorption isotherms. BTC measured for dis-

placement of binary mixtures (TCS plus p-xylene) and single-solute (TCE or p-xylene alone) were identical, suggesting that there is no competitive sorption between these two solutes. These column observations were consistent with sorption isotherm data. (Author's abstract)
W89-04342

TOXIC CONTAMINANTS IN RAINFALL IN CANADA: 1984,
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
W. M. J. Strachan.
Environmental Toxicology and Chemistry ETOCDK, 871-877, November 1988. 1 fig, 5 tab, 23 ref.

Descriptors: *Halogenated pesticides, *Pesticides, *Path of pollutants, *Rainfall, *Canada, Lindane, Heptachlor epoxide, Dieldrin, Chlorinated hydrocarbons, Endrin, Methoxychlor, Cree Lake, Caribou Island, Agawa, Kouchibouguac, Lake Superior, DDT.

Replicate rain samples for most of the 1984 wetfall season were collected from four widely separated site in Canada, and concentrations and loadings of a number of polychlorinated biphenyls and organochlorine pesticides were determined for each location. Comparisons were made among the sites and with results from other years. The major contaminants in 1984 were, in order of concentration, alpha-hexachlorocyclohexane (alpha-HCH or alpha-BHC), lindane and polychlorinated biphenyls (PCBs). Found at low levels were dieldrin, methoxychlor (in the Lake Superior area), DDT residues, endrin (especially at Kouchibouguac), heptachlor epoxide and hexachlorobenzene. The loading of the alpha-HCH/lindane pair was higher at the Atlantic coastal site than at the other locations, possibly because of the greater precipitation there. No geographic trend for PCBs was apparent. For the other substances, no significant pattern to the differences between sites can be discerned. The qualitative similarities of concentrations and loadings at the widely separated locations, however, suggest long-range atmospheric transport. A comparison between results from two Lake Superior sites indicated no shoreline effect on the concentrations of over-lake versus shoreline samples. The differences observed were in accord with those observed in 1983 and were attributed to lack of replenishment from the lake surface. (Author's abstract)
W89-04348

SORPTION BEHAVIOR OF TRIBUTYLTIN ON ESTUARINE AND FRESHWATER SEDIMENTS,
Virginia Inst. of Marine Science, Gloucester Point.
M. A. Unger, W. C. MacIntyre, and R. J. Huggett.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 11, p 907-915, November 1988. 5 fig, 3 tab, 20 ref.

Descriptors: *Path of pollutants, *Pesticides, *Sediments, *Sorption, *Tributyltin, *Tin, *Fate of pollutants, Estuarine environment, Isotherm, Kinetics, Chesapeake Bay, Heavy metals.

Equilibrium sorption of tributyline chloride (TBT) was measured on selected estuarine and freshwater sediments. Isotherms from 24-hour equilibrations were linear. The similarity of sorption and desorption coefficients for these sorbates showed that TBT sorption is reversible. Sorption coefficients decreased with increasing salinity and varied by a factor of two over the salinity range 0 to 34%. Desorption kinetics indicated an initial fast rate followed by a slower rate of desorption, similar to published data for metal ions and hydrophobic organic molecules on sediments. Water and sediment concentrations of TBT at locations in the Chesapeake Bay system were used to calculate apparent sorption coefficients, which generally agreed with laboratory-measured sorption coefficients. Exceptionally high apparent sorption coefficients were found near areas of high vessel activity and maybe due to TBT paint chips in the sediment. (Author's abstract)
W89-04349

SOME REACTIONS OF NATURALLY OCCURRING NUCLEOPHILES WITH HALOALKANES IN WATER,
SRI International, Menlo Park, CA. Chemistry Lab.
W. R. Haag, and T. Mill.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 11, p 917-924, November 1988. 4 fig, 4 tab, 29 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Hydrolysis, *Sulfur, *Halides, Haloalkanes, Nucleophilicity, Reactants, Kinetics, Chemical reactions.

Rate constants for the reactions of a variety of naturally occurring nucleophiles with 1-bromohexane and, to a lesser extent, three other haloalkanes were studied in order to assess their importance relative to hydrolysis in determining the environmental fate of haloalkanes. The sulfhydril ion (HS) minus is generally the most important nucleophile because it is moderately reactive and, among the reactive sulfur nucleophiles, is usually present in the highest concentration. When elemental sulfur is present, polysulfides will be more important for the consumption of 1-bromohexane than HS at pH above approximately 7 because they are 60 times more reactive and their equilibrium concentrations increase with increasing pH. A nucleophilicity scale valid in pure water was established for environmental nucleophiles, using 1-bromohexane as a reference reactant. (Author's abstract)
W89-04350

ENVIRONMENTAL ASSESSMENT OF PESTICIDES - A CONCEPTUAL APPROACH,
Umweltbundesamt, Berlin (Germany, F.R.).
A. W. Klein, and, L. Fiedler, and, P. Muhs-Bonte, and C. Schluter.
Chemosphere CMSHAF, Vol. 17, No. 8, p 1391-1410, 1988. 5 fig, 5 tab, 4 ref.

Descriptors: *Pesticides, *Assessments, *Environmental effects, *Groundwater pollution, Sediments, Surface water, Herbicides, Pesticide toxicity, Toxicity, Aquatic environment, Waste disposal, Incineration, Ecosystems, Path of pollutants.

An assessment of the environmental hazards of pesticides is presented. The objectives of environmental protection are determined by examination of surface waters, groundwater, including sediments, and terrestrial systems. Pesticides are divided into their main subgroups: herbicides, insecticides, acaricides, fungicides, nematicides, rodenticides, growth regulators, and soil fumigants. Active ingredients, use patterns, and application patterns affect the environmental hazard of the pesticides. Various levels of assessment are required to completely analyze the pesticides' environmental impact. The key problems involved in quantifying ecological risks of environmental contaminants are discussed. The necessity of these risk assessment models is stressed. (Stoehr-PTT)
W89-04353

STRUCTURE ACTIVITY RELATIONSHIPS FOR ENVIRONMENTAL PROCESSES 1. HYDROLYSIS OF ESTERS AND CARBAMATES,
Wisconsin Univ., Madison. Dept. of Chemistry.
H. Drossman, H. Johnson, and T. Mill.
Chemosphere CMSHAF, Vol. 17, No. 8, p 1509-1530, 1988. 3 fig, 9 tab, 33 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Molecular structure, *Environmental quality, *Chemical properties, *Esters, *Carbamates, *Hydrolysis, *Correlation analysis, Chemical analysis, Organic compounds.

Hydrolysis of organic chemicals in natural fresh and marine waters affects many important classes of organic compounds, including esters, amides, carbamates, epoxides, imines, silanols, and metal-organics. Structure-activity relationships (SAR) are needed to reliably estimate rate constants for hydrolysis of major classes of chemicals under a variety of environmental conditions as the basis for exposure modeling of chemicals in surface waters. SAR for base-promoted hydrolysis of esters and carbamates have been developed using Hammett and Taft parameters. A master SAR equation correlates hydrolysis rate constants for 103 esters with a range of reactivity of 10 to the 10th power. Two SAR equations are needed to correlate hydrolysis rate constant values for 80 carbamates. The SAR for esters is based on a wide range of aliphatic and aromatic (phenyl) esters but does not include disubstituted or orthosubstituted aromatic esters or non-phenyl aromatic systems. Nor does the SAR include examples of remotely-substituted aliphatic esters in which neighboring groups effects are important. Within this framework, however the SAR should be useful for calculating hydrolysis rate constant values for a wide range of ester and carbamate structures. (Author's abstract)
W89-04356

BIOACCUMULATION OF DYESTUFFS AND ORGANIC PIGMENTS IN FISH. RELATIONSHIPS TO HYDROPHOBICITY AND STERIC FACTORS,
Ecological and Toxicological Association of the Dyestuffs Mfg. Industry, Basel (Switzerland).
R. Anliker, P. Moser, and D. Poppinger.
Chemosphere CMSHAF, Vol. 17, No. 8, p 1631-1644, 1988. 2 fig, 1 tab, 29 ref.

Descriptors: *Path of pollutants, *Pigments, *Chemical properties, *Dyes, *Bioaccumulation, *Fish, Aromatic compounds, Hydrocarbons, Path of pollutants, Molecular structure, Chemical analysis, Biological magnification, Membranes, Permeability.

For 23 disperse dyestuffs, 2 organic pigments and a fluorescent whitening agent, for which experimental bioaccumulation factors in fish are known, partition coefficient octanol/water values were calculated and determined when possible. For comparison, 16 halogenated aromatic hydrocarbons are included. Two parameters were chosen to parameterize the size of the molecules: the molecular weight and the second largest Van der Waals diameter of the molecules, measured on conformation optimized by force field calculations. None of the disperse dyestuffs, even the highly lipophilic ones with partition coefficient octanol/water values less than 3.0, accumulate in fish to a significant degree. It is argued that their large molecular size effectively prevents their permeation through biological membranes and thus their uptake during the time of exposure. For screening organic colorants for their bioaccumulation potential a decision scheme is proposed using as parameters the solubility in water and in octanol, the partition coefficient octanol/water, and the molecular weight and size. This scheme suggests in its last step that there should be no need to perform a fish bioaccumulation test provided the organic colorants have a molecular weight of more than 450 Daltons and a second largest cross section of over 1.05 nanometers. (Author's abstract)
W89-04357

IMPERATIVES OF NONPOINT SOURCE POLLUTION POLICIES,
Harvard Univ., Cambridge, MA. Gordon McKay Lab.
For primary bibliographic entry see Field 5G.
W89-04366

UNCERTAINTY IN PH AND TEMPERATURE CORRECTIONS FOR AMMONIA TOXICITY,
Colorado Univ. at Boulder. Center for Limnology.
W. J. Lewis.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11 p 1922-1929, November 1988. 5 ref.

Descriptors: *Water pollution control, *Water quality standards, *Toxicity, *Hydrogen ion concentration, *Ammonia, *Temperature, *Regulations, Effluents, Coasts, Chlorine, Wastewater, Water quality standards, Water quality, Aquatic life, Limnology.

The strict enforcement of water quality standards is causing many facilities to approach the allow-

ances for discharges on un-ionized ammonia and chlorine. This paper examines the major sources of uncertainty in the pH and temperature corrections of the new criteria documents, and presents estimates of the size of this uncertainty as applied to specific concentrations of un-ionized ammonia. A relationship between pH, temperature, and the toxicity of a given concentration of un-ionized ammonia is presented. However, the national criteria used to assess pollution effects is shown to be a set of rational guidelines, from which the ideal criteria may be found to deviate considerably. (Stoehr-PTT)
W89-04367

MICROORGANISM LEVELS IN AIR NEAR SPRAY IRRIGATION OF MUNICIPAL WASTEWATER: THE LUBBOCK INFECTION SURVEILLANCE STUDY,
Southwest Research Inst., San Antonio, TX.
For primary bibliographic entry see Field 5E.
W89-04371

ASBESTOS AS AN URBAN AREA POLLUTANT,
Alabama Univ. in Birmingham. Dept. of Civil Engineering.
R. Pitt.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1993-2001, November 1988. 5 tab, 32 ref.

Descriptors: *Urban area, *Soil contamination, *Asbestos, *Storm water, *California, *Path of Pollutants, Water pollution control, Fate of pollutants, Runoff, Nonpoint pollution sources, Spatial distribution, Rural areas.

A supplemental investigation of asbestos fibers was conducted in Castro Valley, California, to characterize asbestos fibers in urban stormwater and source area soils and to estimate the fate and movement of asbestos fibers in the urban areas. The study concluded that large numbers of short asbestos fibers can be found throughout an urban area that does not contain any appreciable natural asbestos sources. However, the monitored asbestos fiber abundance varied appreciably for different local source areas and urban area yields were greater than adjacent rural area yields, indicating significant local urban asbestos sources. (Author's abstract)
W89-04375

PESTICIDE TRANSPORT IN SHALLOW GROUNDWATER,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
R. A. Leonard, A. Shirmohammadi, A. W. Johnson, and L. R. Marti.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 776-788, May-June 1988. 3 fig, 12 tab, 21 ref.

Descriptors: *Solute transport, Groundwater pollution, *Groundwater, *Pesticides, *Path of pollutants, *Pesticide residues, Leaching, Sand, Atrazine, Butylate, Aldicarb, Fenamiphos, Hydrologic budgets, Degradation, EDB, Hydraulics, Tile drainage, Soil types, Soil chemistry.

To meet increasing demands for data on pesticide transport to groundwater, residues of selected pesticides, EDB, atrazine, butylate, aldicarb, and fenamiphos were monitored in shallow groundwater beneath a Bonifay sand in the southeast Coastal Plain near Tifton, GA. Pesticides in tile outflow from the treated area were also monitored along with pesticide residue in soil. Low concentrations of atrazine and butylate were present in wells at depths of 1.0 m, 1.5 m, and 2.4 m beginning with the second year of the study. Fenamiphos was detected in only one well throughout the study. However, EDB and aldicarb moved readily to groundwater and in the tile outflow. Results were generally as would be predicted considering chemical properties of the pesticides. However, in these studies it was found that aldicarb was very rapidly converted to the sulfone derivative which was the dominant species in well water and tile outflow. Since little fenamiphos was found in the groundwater and tile outflow, it is speculated that degradation occurs rapidly in these soils. Fenamiphos translocation observed in soil suggested the presence of the more mobile metabolites in soil. Masses of pesticide transported from the treated area were computed using concentrations and estimated water budgets. Comparing leaching losses from the root zone estimated using GLEAMS simulation with groundwater transport shows that less than 10 percent of the leaching losses were actually transported from the treated area in shallow groundwater during the observation period. The difference evidently remained in storage or was absorbed or degraded in transport. (Author's abstract)
W89-04382

CASE STUDY OF URBAN RUNOFF POLLUTION: 1. DATA COLLECTION, RUNOFF QUALITY, AND LOADS,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
D. E. Simpson, and V. C. Stone.
Water SA WASADV, Vol. 14, No. 4, p 229-237, October 1988. 7 fig, 3 tab, 17 ref.

Descriptors: *Pollution load, *Path of pollutants, *Urban runoff, *Data collections, *Water quality, Case studies, Rainfall, Catchment areas, Phosphates, Nitrogen compounds, Heavy metals, Monitoring, Pollutants, Urban planning, Eutrophication, Urban areas, Flow measurement, Chemical analysis, Runoff, Rainfall-runoff relationships, South Africa, Measuring instruments, Nutrients.

A 91.5 ha urban catchment in Pinetown, Natal, South Africa was equipped to measure flow and sample runoff automatically from rainfall at the catchment outfall. The purpose was to measure water quality and determine annual export coefficients for the nutrients which promote eutrophication, viz. nitrogen compounds and phosphates, and a number of toxic heavy metals. Design and operation of the monitoring system is described. High variability in runoff quality and annual pollutant loads was found between years due to different climatic regimes experienced. In wet years washoff from pervious areas of the catchment became increasingly important. The possible harmful effect of runoff to the environment through washoff of toxic metals and the potential of urban development in catchments to promote eutrophication in receiving water is illustrated with results and discussed. (Author's abstract)
W89-04394

ESTIMATING STREAMWATER CONCENTRATIONS OF ALUMINIUM RELEASED FROM STREAMBEDS DURING 'ACID EPISODES',
Freshwater Biological Association, Ambleside (England).
E. Tipping, and J. Hopwood.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 703-712, July 1988. 2 fig, 5 tab, 12 ref.

Descriptors: *Acidic water, *Aluminum, *Streambeds, *Streams, *Water pollution sources, *Acid rain effects, Hydrogen ion concentration, Chemical reactions.

Rates of release of monomeric aluminum (Al-m) were determined for streambed materials placed in a laboratory channel and exposed to acid water, and values of the release rate coefficient, R (micromol Al released per sq m of bed per second) were calculated. Estimates of R were also made from the reported results of experiments in which streams were artificially acidified. The values of R ranged from 0.1 to 3.2 micromol/sq m/s. They decreased with an increase in pH, and were greater for beds containing substantial amounts of the liverwort Nardia compressa than for pebble and/or gravel (mineral) beds. Calculations, using the estimates of R, were performed to assess the contribution of bed-derived Al-m to streamwater concentrations, under conditions where acid water enters stream channels having exchanged negligible H(+) for Al(3+) or base cations in the soil. For typical high-discharge conditions, considerable concentrations of Al-m are possible. For a liverwort-rich bed exposed to water of initial pH 3.5 there may be as much as 60 microM Al-m in the streamwater. At the other extreme, a mineral bed subjected to pH 4.5 water would yield less than 1 microM Al-m. Streambed stores of releasable Al appear sufficient to supply Al to the water for significant lengths of time. (Author's abstract)
W89-04403

POLLUTION SOURCE ANALYSIS OF RIVER WATER AND SEWAGE SLUDGE,
Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie.
J. Nolte.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 857-868, August 1988. 7 fig, 5 tab, 13 ref.

Descriptors: *Water pollution sources, *Pathe of pollutants, *Rivers, *Wastewater analysis, *Elbe River, *Sludge, *Heavy metals, *Toxicity, Chemical analysis, Domestic wastewater, Industrial wastewater, Rainfall, Runoff, Roads, Tracers.

Three methods for tracing environmental pollution sources in water are presented: (1) elemental tracers; (2) analysis of concentration changes; and (3) factor analysis. The methods allowed for the reconnaissance of pollution sources in a harbor segment (Hamburg, West Germany on the Elbe River) contaminated by several wastewater outlets. Factor analysis was also performed to trace sources of toxic heavy metals in sewage sludge. These are derived mainly from motorized traffic and industrial effluents. Domestic wastewater contributes mostly nontoxic elements. Rain water and road runoff also contributed elements to the sludge analyzed. ICP emission spectrometry was used to determine the following elements in water and sludge samples: Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sr, Ti, V, and Zn. (Author's abstract)
W89-04413

WATER QUALITY CHARACTERISTICS AND PHYTOPLANKTON OF POLLUTED VISAKHAPATNAM HARBOUR,
Andhra Univ., Waltair (India). Dept. of Botany.
M. Umamaheswara Rao, and V. Mohanchand.
Marine Environmental Research MERSDW, Vol. 25, No. 1, p 23-43, 1988. 5 fig, 7 tab, 36 ref.

Descriptors: *Water pollution effects, *Harbors, *Water quality, *Phytoplankton, *Primary productivity, Oxygen supersaturation, Biological oxygen demand, Hevy metals, Dissolved oxygen, Species diversity, Turbidity, India, Visakhapatnam Harbor.

Data on water quality characteristics and phytoplankton communities of the polluted Visakhapatnam Harbour were collected for 3 years from April 1980 to March 1983. The waters of the harbor were highly turbid, and the BOD (biological oxygen demand) and dissolved oxygen content varied in the six stations selected. The concentrations of nutrients and heavy metals found in the harbor was 2-300 times higher than that of coastal waters. Fifty species of phytoplankton, belonging to Cyanophyceae, Chlorophyceae, Euglenophyceae, Bacillariophyceae and Dinophyceae were found in different stations. Standing crops of nanoplankton (2-20 micrometers), blue-green algae, Ankistrodesmus falcatus, Nitzschia longissima and Thalassiosira decipiens, were at a maximum at the severely polluted station I; dinoflaggelates, Skeletonema costatum and Cyclotella menegheniana, were highest at the moderately polluted Stations III and IV and many diatoms dominated the less polluted Stations V and VI. The composition and species diversity varied between plankton of harbor stations and open waters. S. costatum was the dominant species among the microplankters of the harbors. Mean standing crop of total plankton varied from 18.0 to 54.0 x 10000 cells/L in surface waters of Stations I to VI and the contributions of nanoplankton was 73.4 to 91.8% of total densities of algal crop. Both nano- and microplankton decreased from surface to 4 or 6 m. Nanoplankton was not observed at 6 m. Cell densities varied in the six harbor stations in relation to changes in the

nutrient concentrations, BOD and turbidity of the water. Minimum circulation, accumulation and utilization of nutrients appear to be responsible for the excessive growth of primary producers and oxygen supersaturation observed in the waters of Visakhapatnam Harbor. (Author's abstract)
W89-04428

STIMULATION OF MICROBIAL ACTIVITIES AND POLYCYCLIC AROMATIC HYDROCARBON DEGRADATION IN MARINE SEDIMENTS INHABITED BY CAPITELLA CAPITATA,
Maryland Univ., Solomons. Chesapeake Biological Lab.
J. E. Bauer, R. P. Kerr, M. F. Bautista, C. J. Decker, and D. G. Capone.
Marine Environmental Research MERSDW, Vol. 25, No. 1, p 63-84, 1988. 8 fig, 3 tab, 56 ref.

Descriptors: *Microbial degradation, *Marine sediments, *Hydrocarbons, *Polychaetes, *Fate of pollutants, Water pollution, Anthracene, Sediments.

The effect of the polychaete Capitella capitata on a variety of sediment microbial activities was determined for 5 months in marine microcosms with or without chronic treatment with the polycyclic aromatic hydrocarbon anthracene. Rates of microbial D(U-C14)glucose assimilation and respiration as well as rates and total amounts of (9-C14)anthracene mineralization were consistently greater in sediments with resident populations of Capitella. Anthracene treatment only affected C14-anthracene mineralization such that after 5 months all sediments under chronic anthracene treatment mineralized C14-anthracene more rapidly than sediments without anthracene or those containing only Capitella. Microbial incorporation of (methyl-H3)thymidine showed no consistent pattern among treatments. The colonization of sediments by total numbers of meiofauna and meiofauna-sized larvae was suppressed in microcosms dosed with anthracene, in contrast to the increased numbers in Capitella-inhabited microcosms. However, when Capitella was also present in anthracene-dosed microcosm sediments, the suppression of total meiofauna numbers was partially offset. The results suggest that mitigation of the effects of organic pollutants, as well as their elimination from sediments, may be enhanced in systems with robust microbe-infauna associations. (Author's abstract)
W89-04430

HYDROCARBONS AND HALOGENATED HYDROCARBONS IN COASTAL WATERS OF THE WESTERN MEDITERRANEAN (FRANCE),
Institut Francais de Recherche pour l'Exploitation de la Mer, Brest. Dept. Environnement Littoral.
M. Marchand, J. C. Caprais, and P. Pignet.
Marine Environmental Research MERSDW, Vol. 25, No. 2, p 131-159, 1988. 6 fig, 6 tab, 52 ref.

Descriptors: *Chlorinated hydrocarbons, *Mediterranean Sea, *Hydrocarbons, *Water pollution sources, *Marine environment, *Water quality. *Coastal waters, Chemical properties, France, Rhone River, Marselles, Wastewater pollution, Marine sediments, Seawater.

Coastal water quality is monitored in France within the framework of the 'Reseau National d'Observation'. To identify pollutant sources and their dispersion in the coastal marine environment, four annual successive cruises have been organized along the French coasts. The results obtained during the second cruise, carried out in the western Mediterranean sea in September, 1984 are presented. Several organic compounds have been analyzed, distinguishing volatile compounds and high-molecular-weight-compounds: total non-volatile hydrocarbons, volatile hydrocarbons (n-alkanes and aromatics), PCBs, chlorinated insecticides (DDT and lindane) and chlorinated solvents (especially CCl3--CH3, CCl4, CHCl=CCl2, CCl2=CCl2). Two major sources of hydrocarbons and halogenated hydrocarbons were found: the Rhone river inputs and the sewage effluents of Marseilles city. The distribution of organic pollutants in seawater and sediments is discussed in relation to their physico-chemical properties and their partitioning between the dissolved and particulate phases. (Author's abstract)
W89-04432

ALIPHATIC HYDROCARBONS AND ISOMERS OF HEXACHLOROCYCLOHEXANE IN SPECIMENS OF WATER, ICE AND SNOW FROM THE GREENLAND SEA,
Arctic and Antarctic Scientific Research Inst., Leningrad (USSR).
F. A. Dmitriyev, and A. N. Gudkov.
Oceanology ONLGAE, Vol. 27, No. 5, p 566-568, April 1988. 1 fig, 1 tab, 15 ref.

Descriptors: *Water pollution, *Hydrocarbons, *Seawater, *Ice, *Snow, Hexachlorocyclohexane isomers, Chemical analysis.

Data on the concentrations of aliphatic hydrocarbons and isomers of hexachlorocyclohexane in specimens of various natural environments (water, snow, and ice) of the Greenland Sea taken during field studies on the ice-breaker Otto Schmidt are presented. The analyses were made with gas chromatographs using capillary and packed columns. The concentrations of aliphatic and chlorinated hydrocarbons were higher in the less saline water beneath the ice. All of the specimen types (ice, snow, and water) collected along the edge of the drift ice off the east coast of Greenland contained industrial organic compounds. The pollutants in the surface waters are at the background level. Larger amounts of hydrocarbons and HCCH isomers were fund in snow than in ice and water indicating that atmospheric transport plays a significant role in the evolution of the composition of the organic matter found in snow and in surface waters. (Brock-PTT)
W89-04435

DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS AND AROMATIC HETEROCYCLES BY A PSEUDOMONAS SPECIES,
Alberta Univ., Edmonton. Dept. of Microbiology.
J. M. Foght, and D. W. S. Westlake.
Canadian Journal of Microbiology CJMIAZ, Vol. 34, No. 10, p 1134-1141, October 1988. 6 fig, 2 tab, 27 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Oil pollution, *Microbial degradation, *Pseudomonas, *Aromatic compounds, Hydrocarbons, Isolation, Culturing techniques, Gas chromatography, Spectrophotometry, Mineralization, Oxidation.

Enrichment cultures were established with the aromatic fraction of a crude oil and screened for aromatic-degrading pseudomonads, using a sprayed-plate technique. One isolate identified as Pseudomonas sp. HL7b was chosen for further study because it oxidized several polycyclic aromatic hydrocarbons and aromatic heterocycles without an apparent lag. Using capillary gas chromatography, spectrophotometry, and radiorespirometry, it was found to be capable of mineralizing and/or oxidizing a wide range of polycyclic aromatic hydrocarbons, S-, N-, and O-heterocyclic analogs, and alkyl polycyclic aromatic hydrocarbons, but not aliphatic hydrocarbons. The isolate displayed two colonial morphologies which correlated with variation in degradative phenotype and hydrophobicity as measured by polystyrene adherence. Pseudomonas sp. HL7b degraded dibenzothiophene co-metabolically by a recognized pathway, but this degradation was constitutive, rather than inducible as reported for other bacteria. While the degradative capability of this isolate is more extensive than others found so far, the ease with which is was isolated suggests that comparable organisms exist in the environment, and these may be exploited environmentally for their degradative capabilities. The occurrence of bacterial species like Pseudomonas sp. HL7b is of obvious importance when considering the fate of recalcitrant aromatic compounds in nature. (Author's abstract)
W89-04443

REGAINED, BUT HIDDEN HOLOMIXIS OF THE AUSTRIAN LAKE TRAUNSEE,
Innsbruck Univ. (Austria). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W89-04481

FREQUENCY AND DEPTH OF VERTICAL MIXING IN AN AMAZON FLOODPLAIN LAKE (L. CALADO, BRAZIL),
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-04482

GEOTHERMAL DENSITY CURRENT,
Electricorp, Hamilton (New Zealand).
For primary bibliographic entry see Field 2H.
W89-04485

LAND USE AND NITROGEN LOSSES: A STUDY WITHIN THE LAHOLM BAY DRAINAGE AREA OF SOUTHWESTERN SWEDEN,
Halland County Administrative Board, Halmstad (Sweden).
S. Fleischer, and S. F. Hamrin.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 181-192, January 1988. 4 fig, 2 tab, 31 ref.

Descriptors: *Agricultural waterheds, *Coastal waters, *Land use, *Nitrogen cycle, *Water pollution sources, *Sweden, *Drainage area, Eutrophication, Nutrients, Cycling nutrients, Solute transport, Nitrogen, Agriculture, Nitrates, Correlation analysis, Rivers, Laholm Bay, Livestock, Poultry, Farming, Hogs, Fertilizers.

The Laholm Bay (300 sq km), Kattegatt, Sweden, although not an estuary, receives large amounts of fresh water from several rivers, carrying a total of approximately 5000 tons of nitrogen and 130 tons of phosphorus. This input of N is largely responsible for the low oxygen content in the bottom waters of the bay. During 1974-1976 blooms of Cladophora glomerata occurred. In 1981 anoxic conditions caused massive kills of bottom animals. The geographic variations in nitrogen losses within the Laholm Bay (Sweden) are described and related to land use. Nearby land use includes intensive farming and pig and poultry production. Significant negative linear correlations were found between losses of Kjeldahl N and the proportion of lakes in the Bolma River area. Relatively high positive correlations were found with the proportion of forest land there and of agricultural land in the Vannea River area. Losses of nitrate-N were strongly positively correlated with the proportion of agricultural areas in the drainage areas of both rivers. The nitrogen losses in the upper and middle parts of the river and the high nitrate-N output from agricultural areas implies that most of the nitrate-N reaching the Laholm Bay comes from the lowland agricultural areas. It is suggested that the agricultural strategy can be changed from intense pig/poultry production with large areas of spring-sown crops to less intense cattle production with grassland areas. (Doria-PTT)
W89-04497

METALS IN CHIRONOMIDAE LARVAE AND ADULTS IN RELATION TO LAKE PH AND LAKE OXYGEN DEFICIENCY,
Toronto Univ. (Ontario). Dept. of Zoology.
L. B. Young, and H. H. Harvey.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 246-251, January 1988. 1 fig, 3 tab, 16 ref.

Descriptors: *Metals, *Limnology, *Path of pollutants, *Midges, *Oxygen deficit, *Acidity, *Lakes, *Acid rain effects, Larval growth stage, Adult growth stage, Growth stages, Hydrogen ion concentration, Iron, Manganese, Aluminum, Zinc, Copper, Cadmium, Heavy metals, Rainfall, Sediments, Lake sediments, Species composition.

Concentrations of Fe, Mn, Al, Zn, Cu, and Cd were measured in chironomid larvae and adults

sampled from three acid lakes in south-central Ontario. Larvae from acid, anaerobic lakes contained lower concentrations of Zn and Cu and adults contained lower Zn and Cd vs. those sampled from the two non-acid lakes. In contrast, larvae from the acid oxic lake contained the greatest concentrations of Zn and Mn and adults contained greater Zn vs. the two non-acid lakes. Concentrations of Fe and Al in larvae were inversely related to lake pH. Mn and Al tended to be lower in adult chironomids from the acid lakes, whereas Fe and Cu of chironomids did not differ among the five lakes sampled. Transfer efficiencies showed that 60 to 100% of Zn, Cu, and Cd concentration was transferred from sediments to larvae and to adults. Abundances of larvae were up to 5-fold greater in two of three acid lakes vs. non-acid lakes, although the non-acid lakes had a more diverse chironomid communities. Estimates of the mass of metal transferred from lake sediments to winged adults show that the mass that leaves the lake via insect emergence is the same for both acid and non-acid lakes, due to the greater densities of chironomids in acid lakes. (Author's abstract)
W89-04504

RELATIONS BETWEEN CHEMISTRY, MICROBIAL BIOMASS AND ACTIVITY IN SEDIMENTS OF A SEWAGE-POLLUTED VS A NONPOLLUTED EUTROPHIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Bostrom.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 451-459, January 1988. 2 fig, 3 tab, 18 ref.

Descriptors: *Path of pollutants, Limnology, *Lake sediments, *Eutrophic lakes, *Water pollution effects, *Aquatic bacteria, *Phosphorus, Sediments, Bacteria, Lakes, Wastewater pollution, Nutrients, Organic matter, Sedimentology, Chemical properties, Biomass, Algae, Metabolism, Sweden, Domestic wastewater.

Chemistry, microbial biomass, and microbial activity in the sediments of two eutrophic lakes in Sweden were compared and the significance of the differences discussed as they relate to phosphorus exchange between sediment and water. Lake Vallentunasjon previously received domestic sewage water, while Lake Fysingen has not been polluted by municipal sewage. It is concluded that a larger potentially mobile organic nutrient pool and a higher microbial activity are likely reasons for the observed larger recycling of nutrients from the sediments of Lake Vallentunasjon as compared to those of Lake Fysingen. The low P-bonding capacity of Lake Vallentunasjon sediments is indicated by the high pool of loosely-bound sedimentary P, the small increase in total P concentration of the sediments during the period of increased internal loading, and the small difference in total P concentration between the sediments of Lake Vallentunasjon and Lake Fysingen. Phosphorus released during mineralization of degradable organic matter may thus, to a large extent, be lost to the water column rather than being transferred to inorganic fractions within the sediments in this lake. (Doria-PTT)
W89-04526

ESTIMATING NONPOINT SOURCES OF PHOSPHORUS TO LAKES,
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
P. Cullen, N. Farmer, and E. O'Loughlin.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 588-593, January 1988. 1 tab, 12 ref.

Descriptors: *Water pollution prevention, *Nonpoint pollution sources, *Phosphorus, *Lakes, *Fertilizers, *Land management, Eutrophication, Watersheds, Forest watersheds, Trophic level, Streamflow, Prediction, Runoff, Flow, Sampling.

The application of superphosphate fertilizer to a forest catchment in Australia was studied to see how such management practices change export coefficients. It is concluded that linear rating curves of discharge and concentration have major limitations as a means of predicting nutrient loads just from discharge data once the rating curve has been measured. Development of such rating curves certainly needs measurements over a range of streamflows. Where longer term data are available, a non-linear model developed under South African conditions needs to be tested on Australian data. It is demonstrated that under some conditions it appears possible to apply superphosphate fertilizer to young pine trees without significant phosphorus export to receiving waters. The best management practice required is for hand application to the base of trees during dry periods although ongoing studies are required to confirm this preliminary interpretation. (Doria-PTT)
W89-04537

EFFECTS OF WIND ON NITROGEN, PHOSPHORUS, AND CHLOROPHYLL IN A SHALLOW NEW ZEALAND LAKE,
Tokyo Univ. (Japan). Dept. of Chemistry.
D. P. Hamilton, and S. F. Mitchell.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 624-628, January 1988. 2 fig, 1 tab, 21 ref.

Descriptors: *Cycling nutrients, *Wind waves, *Path of pollutants, *Water pollution sources, *Nitrogen, *Phosphorus, *Chlorophyll, *Sediments, *Lakes, *New Zealand, *Shallow water, *Wave action, Waves, Wave height, Pigments, Trophic level, Algae, Cyanophytes, Environmental effects.

The effects of wind on nitrogen, phosphorus, and chlorophyll were investigated in Lake Waipori, a moderately large, shallow, eutrophic lake in New Zealand. Increases in total nitrogen, total phosphorus, chlorophyll a, and total pigment were all closely correlated with wave disturbance, expressed as the wave height squared divided by the depth. The wind was strong enough to disturb the sediments on 20% of all days in 1985. The effects altered annual concentrations substantially. Average total phosphorus was 40 mg/cu m, which was 24% higher than the annual average for samples taken on calm days. Total pigment was 32% higher at 5.0 mg/cu m, and chlorophyll a was 20% higher at 2.3 mg/cu m. Total nitrogen was least affected, with the annual mean for all days being only 7% higher (260 mg/cu m) than for calm days. Inorganic nitrogen concentrations are typically low (< 30 mg/cu m), but rather variable and not greatly affected by wave action. It is concluded that, if sediment P is largely available, wave action might favor the development of blue-green algae. If unavailable, although its biological effects may be insignificant, it might well affect the understanding of such lakes, given the current emphasis on total phosphorus as the determinant of lake trophic status. (Doria-PTT)
W89-04543

IN VIVO KINETICS OF BENZO(A)PYRENE AND 7,12-DIMETHYLBENZ(A)ANTHRACENE ASSIMILATION AND METABOLISM IN RAINBOW TROUT,
New York Univ. Medical Center, Tuxedo Park. A. J. Lanza Research Labs.
J. M. O'Connor, A. R. Schnitz, and K. S. Squibb.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 63-67. 2 tab, 7 ref. NIEHS Grant ES00260.

Descriptors: *Water pollution effects, Path of pollutants, *Kinetics, *Benzenes, *Metabolism, *Fish, *Trout, *Comparative studies, Bile, Liver, Aromatic compounds.

The results of comparative studies are presented for the assimilation, elimination, tissue disposition and metabolism of benzo(a)pyrene and 7,12-dimethylbenz(a)anthracene in rainbow trout after administration of known doses of these contaminants via the digestive tract. Results show that whole body elimination of 7,12-dimethylbenz(a)anthracene is more rapid than benzo(a)pyrene. Data suggest that 7,12-dimethylbenz(a)anthracene is more readily excreted by routes other than the hepatobiliary system than is benzo(a)pyrene. Both compounds are excreted into the bile primarily as metabolites more polar than the parent compounds. (Miller-PTT)
W89-04546

FISH HEPATOCYTE MODEL FOR THE INVESTIGATION OF THE EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
For primary bibliographic entry see Field 5C.
W89-04547

PRESENCE OF ZN,CU-BINDING PROTEIN IN LIVER OF FRESHWATER FISHES IN THE ABSENCE OF ELEVATED EXOGENOUS METAL: RELEVANCE TO TOXIC METAL EXPOSURE,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W89-04548

METALLOTHIONEIN AND HEAVY METAL LEVELS IN RAINBOW TROUT (SALMO GAIRDNERI) DURING EXPOSURE TO CADMIUM IN THE WATER,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W89-04549

EVIDENCE FOR IMPAIRED REPRODUCTION IN WHITE CROAKER (GENYONEMUS LINEATUS) FROM CONTAMINATED AREAS OFF SOUTHERN CALIFORNIA,
Southern California Coastal Water Research Project, Long Beach.
For primary bibliographic entry see Field 5C.
W89-04551

ANTICHOLINESTERASE EFFECT OF THE COTTON DEFOLIANT S,S,S-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) ON CHANNEL CATFISH,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-04552

INFLUENCE OF CADMIUM EXPOSURE ON PLASMA CALCIUM, VITELLOGENIN AND CALCITONIN IN VITELLOGENIC RAINBOW TROUT,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W89-04553

COMPARATIVE HISTOPATHOLOGICAL EFFECTS OF CHEMICALLY CONTAMINATED SEDIMENT ON MARINE ORGANISMS,
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W89-04562

5C. Effects Of Pollution

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 1.
Ecology and Environment, Inc., Buffalo, NY.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 025. Price codes: A22 in paper copy, A01 in microfiche. Final Report for Air Force Plant 3 Tulsa, Oklahoma, May 1987. 533p, 27 fig, 21 tab, 12 append. USAF Contract F33615-83-D-4003.

Descriptors: *Hazardous wastes, *Path of pollutants, *Water pollution effects, *Fate of pollutants, *Groundwater pollution, Tulsa, Oklahoma, Organic compounds, Volatile organic compounds, Oil,

Phenols, Polychlorinated biphenyls, Titanium, Soil contamination.

Technical and analytical services in support of Air Force Installation Restoration Program (IRP) were applied to the Phase II, Stage 1, investigation at Air Force Plant 3, Tulsa, Oklahoma. The field investigation was conducted between 3 November 1983 and 11 December 1985, and involved work at seven sites at the plant. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils and groundwater. Samples were analyzed for various parameters including volatile organics, oil and grease, total organic halogens, total organic carbon, phenols, PCBs, and titanium. Results of the investigation indicted that past waste handling and disposal practices had caused various degrees of soil and groundwater contamination at six of the seven sites. Follow-up work has been recommended at five sites to better define the extent of contamination. One site was judged to require no follow-up action, and one site is recommended for Phase IV (remedial action) work. (Author's abstract)
W89-03337

ASSESSMENT OF THE ECOTOXICOLOGICAL HAZARD OF SEDIMENTS IN WAUKEGAN HARBOR, ILLINOIS,
Illinois Natural History Survey, Champaign. Aquatic Biology Station.
P. Ross, M. Henebry, L. Burnett, and W. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-184833. Price codes: A04 in paper copy, A01 in microfiche. Report No. HWRIC RR-018, January 1988. 68p, 11 fig, 16 tab, 112 ref.

Descriptors: *Ecological effects, *Toxicity, *Water pollution effects, *Sediments, *Waukegan Harbor, *Illinois, *Polychlorinated biphenyls, Invertebrates, Environmental effects, Toxicity, Aquatic plants, Bioassay, Protozoa, Duckweed, Lettuce, Millet.

Waukegan Harbor, on the western shore of Lake Michigan 30 miles north of Chicago, received large inputs of PCBs between 1948 and 1971, much of which remains in harbor sediments. To evaluate the environmental hazard of these sediments, 24 samples were examined for PCB concentrations and acute invertebrate, community, and plant toxicity. Total PCB concentrations in sediment samples ranged from 5 to 17,251 mg/kg, in agreement with ranges reported in previous studies. All but three stations are above the 'safe' level of 10 mg/kg recommended in previous investigations. In three acute bioassays (Microtox bacterial test, Selenastrum capricornutum algal bioassay, Panagrellus redivivus nematode growth and development test) sediment elutriates from the 24 stations sampled showed moderate to extreme overall toxicity and at least one highly toxic response from each station. All nematode tests were run at 10% elutriate, and the levels of mortality observed at this concentration (up to 97%) are extraordinarily high. In analyses of bioassay response with PCB concentrations, only the total number of positive tests per station produced a significant correlation. While the harbor is clearly severely contaminated with PCBs, high overall toxicity is not restricted to areas with high PCB concentrations. Other factors (oils and grease, lead, aluminum, etc.) may be involved in producing these toxic responses. PCB contamination in Waukegan Harbor sediment produced adverse effects in protozoan community bioassays. When exposed to sediment elutriates, mature communities exhibited a reduction in number of species. Colonization of fresh substrates showed significant responses at elutriate concentrations only one-fourth as strong as those required to affect mature communities. (Lantz-PTT)
W89-03345

CAUSES OF WETLAND LOSS IN THE COASTAL CENTRAL GULF OF MEXICO. VOLUME I: EXECUTIVE SUMMARY.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-200803. Price codes: A03 in paper copy, A01 in microfiche. Report No. MMS87-0119, January 1988. 32p, 14 fig, 7 tab. Edited by R. Eugene Turner and Donald R. Cahoon. Minerals Management Service Contract 14-12-0001-30252.

Descriptors: *Water pollution effects, *Oil fields, *Coastal marshes, *Coastal waters, *Gulf of Mexico, *Wetlands, *Environmental effects, Oil pollution, Natural gas, Continental shelf.

In 1985, the Minerals Service initiated an investigation to study the causes of wetland loss in the coastal Gulf of Mexico as part of its outer continental shelf environmental studies program. The purpose of the two-year study was to investigate the factors that contribute to wetland loss and to determine specifically what percentage of the loss is directly and indirectly related to Federal offshore oil and gas development. The primary goal of the Coastal Effects Program is to delineate the onshore impacts of offshore oil and gas development activities. The final report, prepared in three volumes, describes the extent of the contribution of OCS development to coastal landloss. Volume I is this executive summary. Volume I further provides an introduction of the study and describes the study area, project goals and approach, results, and consensus. (Author's abstract)
W89-03357

RESEARCH ACTIVITY DESCRIPTORS, FY 88.
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-204748. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/9-88/006, March 1988. 241p, 7 fig, 4 tab.

Descriptors: *Research priorities, *Water pollution effects, *Acid rain, Environmental effects, Acidification, Chemical analysis, Surface water, Ecosystems, Water quality, Monitoring.

The Aquatic Effects Research Program (AERP) was developed to determine the effects of acidic deposition on surface waters of the United States. The goal of the program is to characterize and quantify with known certainty the subpopulation of surface waters that will respond chemically to current and changing acidic deposition and to determine the biological significance of observed or predicted changes. The AERP has five major component programs designed to increase understanding of long-term acidification: the National Surface Water Survey, the Direct/Delayed Response Project, Watershed Processes and Manipulations, Long-Term Monitoring, and Indirect Human Health Effects. Short-term acidification is being addressed through the Episodic Response Project, and issues of both chronic and acute acidification are addressed through Biologically Relevant Chemistry. The results of these eight programs will be used collectively in the Synthesis and Integration Program, designed to provide information that allows: (1) the policy questions to be addressed quantitatively and (2) the AERP goal to be satisfied. Critical issues for the future include: (1) contributing to the 1990 goal of the National Acid Precipitation Assessment Program to assess the effects of acidic deposition on surface waters in the United States, (2) implementing research to verify model predictions relating to future effects of acidic deposition on aquatic ecosystems, and (3) establishing a long-term monitoring network capable of detecting biologically significant changes in the chemistry of representative lakes and streams that can be related to known regional populations of aquatic systems. (Author's abstract)
W89-03374

ECONOMIC VALUATION OF ACIDIC DEPOSITION DAMAGES: PRELIMINARY RESULTS FROM THE 1985 NAPAP DAMAGE ASSESSMENT,
Battelle Pacific Northwest Labs., Richland, WA.
J. M. Callaway, R. F. Darwin, and R. J. Nesse.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-005690. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA--13140, September 13, 1985. 39p, 6 fig, 4 tab, 44 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Acid rain effects, *Economic aspects, *Acid rain, Damage, Management planning, Agriculture, Forestry, Fishing, Recreation, Simulation analysis.

Methods are identified which are used to evaluate the economic damages of acid deposition in the 1985 Damage Assessment being coordinated by the National Acid Precipitation Program. It also presents the preliminary estimates of economic damages for the Assessment. Economic damages are estimated for four effect areas: commercial agriculture and forests, recreational fishing and selected types of materials. In all but the last area, methods were used which incorporated the behavioral responses of individuals and firms to simulated physical damages to resources at risk. The analysis of materials' damages was performed using the more traditional damage function approach. Results should be interpreted for policy purposes with caution, for several reasons. First, the damages estimates were calculated assuming fairly pristine base case conditions. It remains to be seen if these conditions are consistent with optimal policies to reduce the precursors of acid deposition. Thus, these damages estimates should not be construed as estimates of the benefits of reducing acid deposition. Furthermore, the damage estimates presented in this study do not cover the full range of economic losses that may occur within the four selected areas. Finally, there is a great deal of uncertainty about the physical effects of acid deposition in the two areas in which economic damages could conceivably be large enough to warrant concern, namely: commercial forests and common building materials. (Lantz-PTT)
W89-03382

EFFECT OF CADMIUM-BEARING SEWAGE SLUDGE ON CROP PLANTS AND MICROORGANISMS IN TWO DIFFERENT SOILS,
Naples Univ. (Italy). Ist. di Microbiologia Agraria.
For primary bibliographic entry see Field 5E.
W89-03410

EFFECT OF SEWAGE SLUDGE APPLICATION TO BERMUDAGRASS ON FORAGE QUALITY, PRODUCTION, AND METAL ACCUMULATION,
Sam Houston State Univ., Huntsville, TX. Dept. of Agriculture and Natural Resources.
For primary bibliographic entry see Field 5E.
W89-03412

TOXICITY OF ALUMINUM TO TWO ACIDO-TOLERANT GREEN ALGAE,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
A. Claesson, and L. Tornqvist.
Water Research WATRAG, Vol. 22, No. 8, p 977-983, August 1988. 6 fig, 2 tab, 11 ref.

Descriptors: *Acidity, *Acid rain effects, *Chlorophyta, *Aluminum, *Toxicity, *Water pollution effects, Algal growth, Resistance, Algae.

Two green algae, Monoraphidium dybowskii and Stichococcus sp., were exposed to aluminum oxide at some ecologically relevant concentrations within a pH range of 5.0-6.0. Growth experiments in batch cultures showed some difference in tolerance response between the two species. Cell decomposition was detectable at 0.10 mg Al/l but was more pronounced at higher Al concentrations. Monoraphidium showed higher tolerance to aluminum oxide than did Stichococcus when EC50 values were considered. The growth rate of this alga was reduced to 50% of the control when it was exposed to 1 mg Al/l. The EC50 value for Stichococcus was 0.52 mg Al/l. Upon measurement of the 50% reduction in maximum cell biomass, about the same values (0.4 mg Al/l) were noted for both algae. Calculation of the area under the growth curve gave a more integrated growth

response resulting in intermediate values for both algae but still half as high for Stichococcus as for Monoraphidium. However, no effective concentration and least concentration significant effect (LCSE) of aluminum oxide, were signified by lower values (around 0.02 mg/l) for Monoraphidium compared with those (0.11-0.23 mg/l) for Stichococcus, which responded more dramatically when the Al concentration was increased. The increase in cell number production was progressively more affected during the growth experiments. Cells of Stichococcus, however, seemed to adapt to some extent after more than 3 days of exposure, showing higher tolerance at intermediate Al concentrations after some additional days of exposure. (Author's abstract)
W89-03434

ACUTE TOXICITY OF TRIBUTYLTIN TO SELECTED CHESAPEAKE BAY FISH AND INVERTEBRATES,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
S. J. Bushong, L. W. Hall, W. S. Hall, W. E. Johnson, and R. L. Herman.
Water Research WATRAG, Vol. 22, No. 8, p 1027-1032, August 1988. 3 tab, 25 ref. NAVSEA Contract N0024-85-C-5301.

Descriptors: *Tin, *Tributyltin, *Metal organic pesticides, *Toxicity, *Water pollution effects, *Chesapeake Bay, *Fish, *Invertebrates, Fish larvae, Shrimp, Copepods, Amphipods, Menhaden, Silverside, Resistance.

Tributyltin (TBT) is commonly used as a biocide in antifouling paints for both recreational and commercial watercraft. Its increasing widespread use has caused concern about its potential effect on nontarget aquatic organisms. The high levels of TBT reported in Chesapeake Bay are not unusual. It would appear that in some areas with high boating activity, such as marinas, yacht basins, and associated tributaries, peak TBT levels may exceed concentrations which are acutely toxic to some sensitive organisms in the laboratory. Data from acute toxicity tests are used extensively by regulatory agencies in evaluating the toxicity of a compound. However, direct application of these TBT toxicity data to predict biological response in the environment should be made cautiously until extensive in-situ testing has been completed. Acute tributyltin toxicity experiments were conducted on selected Chesapeake Bay biota. Four invertebrate and five fish species were evaluated. Tests were conducted using continuous-flow conditions and TBT concentrations were measured every 24 hr in test containers. Test solutions were generally within 10-15% of the predicted concentrations. Estuarine copepods were very sensitive to TBT. A 72-hr LC50 of 0.6 micrograms/l TBT was reported for Eurytemora affinis; Acartia tonsa had a 48 hr LC50 of 1.1 micrograms/l TBT. The most resistant invertebrate tested was the grass shrimp, Palaemonetes sp. (96-hr LC50 > 31 micrograms/l TBT). The most sensitive fish species tested were larval inland silversides (Menidia beryllina), (96-hr LC50 = 3.0 microgram/l TBT) and juvenile Atlantic menhaden (Brevoortia tyrannus), (96-hr LC50 = 4.5 micrograms/liter TBT). Mummichogs (Fundulus heteroclitus) and sheepshead minnow (Cyprinodon variegatus), (96-hr LC50 = 23.8 and 25.9 micrograms/liter TBT, respectively) were the most resistant fish species tested. Concentrations of TBT exceeding the LC50 values reported for both copepod species have been found in the water column from marinas in northern Chesapeake Bay.)
W89-03440

EFFECTS OF WATER ACIDIFICATION ON THE DECOMPOSITION OF JUNCUS BULBOSUS L.,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
R. S. E. W. Leuven, and W. J. Wolfs.
Aquatic Botany AQBODS, Vol. 31, p 57-81, No. 1-2, July 1988. 7 fig, 4 tab, 58 ref.

Descriptors: *Acid rain effects, *Acidification, *Acidic water, *Water pollution effects, *Aquatic plants, *Decomposition, Detritus, Macrophytes, Hydrogen ion concentration, Aluminum, Fungi, Bacteria, Microbial degradation, Leaching.

Several field and laboratory experiments were performed to study the impact of acidification on the decomposition of Juncus bulbosus. The breakdown of coarse detritus of this aquatic macrophyte appeared to be very slow. After 7 weeks of incubation in an acidified and a circumneutral moorland pool the remaining fraction of Juncus leaves varied between 46 and 75% of the original organic weight. Differences in decay patterns were observed among both systems. Furthermore, the breakdown rates were highly dependent on the season. Highest weight loss rates were recorded at high pH during the summer period. In acidified water and during the winter period the breakdown rates were reduced. Nutrient dynamics of detritus in the circumneutral soft water and the acidified system differed remarkably. In litter bags laid down on the bottom surface of the acidified moorland pool the density and diversity of macroinvertebrate assemblages was generally lower than in the bags immersed in the non-acidified body of water. In particular, the abundance of detritivores and herbivores at low pH was strongly reduced. However, in winter qualitative and quantitative differences in the macro-fauna in the litter bags did not significantly affect decay rates of detritus. Laboratory studies revealed that the pH, bicarbonate concentration and aluminium content of the water particularly influenced the rate of decomposition of the pre-dried Juncus material. The extent of leaching and autolysis and the relative importance of fungi and bacteria in the decomposition of fresh Juncus leaves were studied using antifungal and antibacterial agents. In the laboratory leaching and autolysis accounted for 28-32% of the organic weight loss of coarse detritus. Leaching and autolysis caused the highest weight loss in the strongly acid medium. After 37 days of incubation in control media with pH 3.5 and 5.6 total organic weight loss was 55 and 59%, respectively. At pH 3.5 and 5.6 microbial decomposition accounted for organic weight losses of 23 and 31%, respectively. At low pH microbial decomposition was dominated by fungi, whereas, at pH 5.6 both fungi and bacteria played an important role in the breakdown processes. The contribution of macroinvertebrates to the breakdown of Juncus detritus seemed to be of minor importance. (Author's abstract)
W89-03467

POPULATION TRENDS IN THE PHYTOPLANKTON AND ZOOPLANKTON OF THE UPPER AND MIDDLE ST. JOHNS RIVER, FLORIDA, 1983-1984,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
J. R. Yount, and T. V. Belanger.
Florida Scientist FLSCA, Vol. 51, No. 2, p 76-88, Spring 1988. 1 fig, 3 tab, 13 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Agricultural runoff, *Population dynamics, *Aquatic populations, Chlorophyta, Diatoms, Water pollution sources, Nutrients, Chlorophyll a, Chlorella, Cyanophyta, Anacystis, Anabaena, Rivers, Eutrophication, Water pollution effects.

Monthly phytoplankton and zooplankton sampling at 12 stations in the upper and middle St. Johns River between October, 1983 and May, 1984 provided data for comparison with historical taxonomic data. Although zooplankton communities varied in composition throughout the river, the phytoplankton data revealed several trends. Centrate diatoms and single celled green algae, primarily Chlorella and Chlorococcum, were common in the upper river, which was characterized by low chlorophyll a. The blue greens Anacystis, Anabaena and Lyngbya were dominant in the more eutrophic middle section of the river. Periodic bloom conditions of blue green algae have been noted previously in the upper river lakes, and blooms also occurred during this study. These blooms may be related to high nutrient loading from agricultural pumping activities. (Author's abstract)
W89-03468

UPDATE OF THE STATUS OF WHITE WHALES DELPHINAPTERUS LEUCAS IN THE SAINT LAWRENCE ESTUARY, CANADA,
Arctic Biological Station, Ste. Anne de Bellevue (Quebec).
D. E. Sergeant, and W. Hoek.
Biological Conservation BIOCOK, Vol. 45, No. 4, p 287-302, 1988. 5 fig, 2 tab, 24 ref.

Descriptors: *St. Lawrence estuary, *Polychlorinated biphenyls, *Whales, *Water pollution effects, *DDT, *Canada, *Population dynamics, *Population density, Estuaries, Arctic, Animal population, Chlorinated hydrocarbons.

The population of white whales Delphinapterus leucas Pallas in the Saint Lawrence estuary declined rapidly between the 1930s and the 1970s, probably due successively to commercial hunting followed by sport hunting; pollutant chemicals, the most likely candidates being polychlorinated biphenyls or their impurities such as dioxins, may have prevented subsequent increases. A population, apparently stable between 1973 and 1985 at about 500 animals, inhabits a historically reduced range in spring, summer and autumn of about 100 linear km (2000 sq km). In winter the range extends seaward. Estimated gross reproductive rate is about 0.055 per annum, or less than half that estimated for white whales in the Arctic, giving an annual production of about 27 animals, and there is probably negligible immigration from outside the Saint Lawrence. There are on average about 12 carcasses found each year during the ice-free period, or about 16 calculated per annum, and a few animals lost by a one-way emigration southward, suggesting that about one-third of deaths are not reported. The population has been legally protected from hunting since 1979. All islands in the middle Saint Lawrence estuary had become sanctuaries by 1986, giving coastal habitat protection and slowing down increase of boat traffic in the area inhabited by white whale mothers and calves. While only experimental work can elucidate the precise pollutants, reduction of input of all organochlorines to the Great Lakes-Saint Lawrence system seems essential if the population's reproductive rate is to recover. (Author's abstract)
W89-03473

THREATS TO THE FRESHWATER PEARL MUSSEL MARGARITIFERA MARGARITIFERA L. IN CENTRAL EUROPE,
Bayreuth Univ. (Germany, F.R.). Dept. of Animal Ecology.
G. Bauer.
Biological Conservation BIOCOK, Vol. 45, No. 4, p 239-253, 1988. 6 fig, 1 tab, 22 ref.

Descriptors: *Mussels, *Water pollution effects, *Trout, Population density, Eutrophication, Population dynamics, Europe, Phosphate, Nitrate, Calcium.

Data on threats affecting the life cycle of the endangered freshwater pearl mussel Margaritifera margaritifera are presented. There was no evidence to suggest that a change in density or age structure of host fish (brown trout) populations has contributed to the decline of mussels. The factor of greatest impact was pollution. Mortality of the adult stage exhibited a positive correlation with the concentration of nitrate in the water and, in particular, phosphate, calcium and BOD5 were correlated with decreasing survival and establishment of juvenile mussels. As fertility (i.e. production of glochidia) is maintained even in sparse populations, and in polluted rivers, the populations should recover if the causes of decline are removed. Eutrophication should therefore be prevented. It might accelerate recovery of sparse populations if the numbers of young mussels released by the hosts were increased by introducing artificially infected fish. (Author's abstract)
W89-03474

EFFECTS OF SIMULATED ACID RAIN ON EXTRACTABLE AND LEACHED CATIONS OF A LEXINGTON SILT LOAM,
Louisiana Agricultural Experiment Station, Baton

Rouge.
For primary bibliographic entry see Field 5B.
W89-03489

SECONDARY PRODUCTION AND ENERGY TRANSFER IN THE POLLUTED RIVER SAALE (THURINGIA, SOUTHERN GDR),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
W. Schonborn.
Internationale Revue der gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 5, p 539-557, 1987. 5 fig, 4 tab, 72 ref.

Descriptors: *Water pollution, *Bacteria, *Self-purification, *Energy transfer, *Rivers, *Food chains, Secondary productivity, Fish, Invertebrates, Saale River, Ecosystems, East Germany.

In the middle reaches of the polluted Saale Rivers, East Germany, (alpha-mesosaprobic region) there are two final consumers: Erpobdella octoculata (leech) and fish. Three main flows of energy in the river ecosystem are described and quantified. The food web is only poorly developed. In the River Saale Erpobdella is the main predator and controls most of the meio- and macrozoobenthos. The type of energy transfer described here seems to predominate in polluted rivers. A qualitatively different type of energy transfer predominates in clean running waters. The total energy flow seems to be a mechanism to maintain the activity of bacteria. Therefore, the energy flow is directly related to the self-purification capacity of the river. (See also W89-03493) (Sand-PTT)
W89-03494

SEASONAL BIOMASS AND PRODUCTIVITY OF THE SUBMERGED MACROPHYTES IN A POLLUTED WISCONSIN STREAM,
Wisconsin Univ.-Madison. Dept. of Botany.
For primary bibliographic entry see Field 2E.
W89-03498

DISTRIBUTION OF PLANKTONIC CILIATES IN HIGHLY COLOURED SUBTROPICAL LAKES: COMPARISON WITH CLEARWATER CILIATE COMMUNITIES AND THE CONTRIBUTION OF MYXOTROPHIC TAXA TO TOTAL AUTOTROPHIC BIOMASS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. R. Beaver, T. L. Crisman, and R. W. Bienert.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 51-60, August 1988. 5 fig, 4 tab, 27 ref.

Descriptors: *Lakes, *Subtropic zone, *Zooplankton, *Eutrophication, *Florida, *Limnology, *Trophic level, *Color, *Phytoplankton, *Protozoa, Biomass, Standing crops, Chlorophyll a, Bacteria, Algae, Seasonal variation, Oligotrophic lakes.

The planktonic ciliate communities of 11 organically coloured north and central Florida lakes representing a variety of trophic conditions were examined during 1979-80. The total abundance and biomass of ciliates were not significantly different from comparable clearwater lakes and only minor taxonomic replacements were noted at the order level. Timing of population peaks of oligotrophic lakes was dissimilar to clearwater lakes of the same trophic state, but seasonality in mesotrophic and eutrophic lakes resembled patterns described for comparable clearwater lakes. Various ciliate components were strongly correlated with chlorophyll a concentrations, but only moderately correlated to dominant phytoplankton groups. No significant correlations were found between ciliate components and bacterial abundance. Myxotrophic taxa numerically dominated oligotrophic systems, particularly during midsummer, and accounted for a large percentage of the total ciliate biomass. Estimates of the ciliate contribution to total autotrophic biomass indicate that these zoochlorellae-bearing protozoa may account for much of the autotrophic biomass during midsummer periods in coloured lakes, and thus may lead to an overestimation of phytoplankton standing crops available to zooplankton grazers if chlorophyll a is used as a surrogate measure of algal biomass. (Author's abstract)
W89-03499

FLORISTIC CHANGES IN SHALLOW SOFT WATERS IN RELATION TO UNDERLYING ENVIRONMENTAL FACTORS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W89-03500

PRELIMINARY EMPIRICAL MODELS OF THE HISTORICAL AND FUTURE IMPACT OF ACIDIFICATION ON THE ECOLOGY OF WELSH STREAMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, N. S. Weatherley, P. V. Varallo, and P. G. Whitehead.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 127-140, August 1988. 6 fig, 1 tab, 50 ref.

Descriptors: *Acid rain, *Acidification, *Water pollution effects, *Acidic water, *Trout, *Invertebrates, *Model studies, *Wales, Simulation, Coniferous forests, Moorlands, Aluminum, Sulfates, Hydrogen ion concentration, Streams, Hardness, Ecology, Forests.

A preliminary approach to modelling the impact of acidification on the ecology of two Welsh streams is described. Output from the hydrochemical Model of Acidification of Groundwaters in Catchments (MAGIC) was used to derive empirical models which predicted brown trout Salmo trutta survival, trout density and invertebrate assemblage type. The models were used for hindcasts between 1844 and 1984 under conifer forest and moorland conditions. Forecasts involved each of these land uses with sulfate deposition either continued at 1984 levels or reduced by 50%. Trout survival times and trout densities in the models declined markedly between 1844 and 1984. The most severe decline occurred under simulated forest, where high aluminum concentration led to the virtual elimination of trout in both streams. In forecasts, only in simulated moorland with sulfate deposition reduced by 50% of 1984 levels, was further decline in trout population retarded. There was no marked recovery in trout density under any of the conditions examined. Invertebrate assemblages in streams during the 19th century may have differed from those now existing in nearby moorland streams which are presently circumneutral. Past chemical conditions were unusual (<3 mg/L total hardness, pH>5.7 and low aluminum) by present-day standards, and were outside the range of the invertebrate model until about 1940. Between the 1940's and 1984 there was no change in invertebrate fauna under the moorland scenario despite some acidification. However, simulated forest advanced the appearance of the most impoverished assemblage type, which did not recover in spite of reduced deposition. There are several uncertainties with the models in their present form, and some methods are suggested for their testing and validation. (Author's abstract)
W89-03503

MANGANESE CYCLING IN COASTAL REGIONS: RESPONSE TO EUTROPHICATION,
Rhode Island Univ., Narragansett. Marine Ecosystems Research Lab.
C. D. Hunt, and J. R. Kelly.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 5, p 527-558, May 1988. 13 fig, 9 tab, 51 ref. EPA Grants CR807795-01, CR810265-01, CR81026502; NOAA Grant 83ABD00008; Cornell University Grant OSPSC771; EPA Cooperative Agreement No. CR812685.

Descriptors: *Coastal waters, *Water pollution effects, *Manganese, *Cycling nutrients, *Eutrophication, *Narragansett Bay, Seasonal variation, Sediment-water interfaces, Water temperature, Primary productivity.

Changes in Mn distribution in water and bottom sediments, and the flux rates between these two, were followed in a nutrient enrichment experiment using marine mesocosms. The experiment involved a geometric series of daily nutrient additions (N, P, Si) to 6 mesocosm tanks for a 2-3 year period. Changes occurred in sediment-water flux rates of dissolved Mn, in total Mn in the water, and in Mn concentrations of sediment pore waters and solids; the direction and magnitude of change in each of these parameters varied somewhat by treatment. The specific nature of the alteration in Mn cycling varied substantially among treatments, relating to the biological, as well as geochemical conditions, specific to any given tank. Seasonal patterns in Mn concentration and fluxes, normally evident as correlations with temperature, were occasionally altered; disruption of sediment-water interactions of Mn, which shape the water column concentration of Mn during warm seasons, was significant. A general model of benthic Mn flux, as influenced by primary production and eutrophication, as well as the past history of the sediments, was suggested by the data. The rates of dissolved Mn release from sediments, measured in a time series of short-term incubations with an in situ chamber, did not reflect well the longer-term observed changes in sediment inventory of Mn across the gradient. Progressively larger loss of sediment Mn inventory with increased nutrient loading was suggested; loss generally led to elevated Mn in the water, a change itself determined in each situation by imbalances between the processes of Mn particle deposition and remobilization on Mn from the sediments. Thus, while the details of Mn cycling varied at different levels of eutrophication and were influenced by the composition and activity of the biological community, the major general consequence of nutrient enrichment was the potential for increased export of Mn from more enriched systems to their offshore receiving waters. Budget calculations suggested that loss of Mn previously stored within bottom sediments could increase Mn export rates by 33-100% within the first few years of enhanced nutrient loading of a shallow coastal area such as Narragansett Bay. (Author's abstract)
W89-03506

TRENDS IN NUTRIENT AND OXYGEN CONDITIONS WITHIN THE KATTEGAT: EFFECTS OF LOCAL NUTRIENT SUPPLY,
Goeteborg Univ. (Sweden). Dept. of Oceanography.
L. Andersson, and L. Rydberg.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 5, p 559-579, May 1988. 12 fig, 3 tab, 16 ref.

Descriptors: *Nutrients, *Oxygen, *Water pollution effects, *Nitrogen, *Phosphorus, *Primary productivity, *Estuaries, *Kattegat, *Baltic Sea, Seasonal variation, Data interpretation, Data collections, Phytoplankton, Surface water, Deep water, Salinity.

The Kattegat forms the outer part of the Baltic estuary. It is characterized by a stable 2-layer stratification maintained by approximately equal supplies of low saline water from the Baltic and high saline oceanic water from the Skagerrak. The nutrient supply to these waters increased rapidly during the past decades and oxygen deficits have been reported from different parts of the estuary. Trends in nutrient and oxygen concentrations within the surface and deep waters of the Kattegat and adjacent waters were calculated. This was done with available data for the past decades, with reference to nutrient supply and phytoplankton production. Oxygen concentrations within the deep water decreased from 4.58 to 4.08 ml/L between 1971 and 1982, indicating a 50% increase in oxygen consumption. Concentrations of total N, total P and inorganic N increased simultaneously, both in the surface water during the winter and in the deep-water during the summer. Changes in total N and total P were dominated by the Baltic water, while local supply to the Kattegat dominated the changes in inorganic N. Increases in total N and total P suggest a successively increasing biomass. The importance of local nutrient supply to the Kattegat was studied by comparing expected nutrient concentrations within the surface water

(due to exchange with adjacent waters) with actually observed concentrations. (Author's abstract)
W89-03507

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: 3. EPIFAUNA ON PIER-PILINGS,
Tromsoe Univ. (Norway). Dept. of Marine Biology.
K.- J. Jakola, and B. Gulliksen.
Sarsia SARIA3, Vol. 72, No. 3/4, p 173-182, 1987. 15 fig, 1 tab, 31 ref.

Descriptors: *Water pollution effects, *Wastewater disposal, *Benthic fauna, Municipal wastewater, Macroinvertebrates, Species diversity, Tromso, Norway.

The epibenthic macrofauna of wooden pier-pilings at 6 sampling stations in the Tromso area were investigated at 6-7 week intervals between August 1979 and September 1980. The aim of the study was to determine if there were qualitative and quantitative differences between the fauna near the city of Tromso and that closer to the open sea, and if any faunal differences could be related to sewage from the city. The substrate and hydrographical environment (salinity, temperature, oxygen) were fairly similar at all sampling stations. The stations furthest away (c. 15 km) from the main sewage outlets had more species, a higher diversity and a lower dominance than the other sampling stations. Although log-normal distribution and Czekanowski's index of similarity also suggested that the faunal differences between the most remote stations and those nearest the sewage outlets were significant, these differences were small. It is concluded that the sewage from the city had relatively small effects on the fauna due to the strong tidal water exchange and mixing around the island of Tromso, especially in the sound between the island and the mainland. (Author's abstract)
W89-03508

OIL POLLUTION AND PLANKTON DYNAMICS: II. ABUNDANCE PATTERNS OF CILIATES INSIDE AND OUTSIDE ENCLOSURES AND THE RESPONSE OF CILIATES TO OIL DURING THE 1980 SPRING BLOOM IN LINDASPOLLENE, NORWAY,
Bergen Univ. (Norway). Dept. of Marine Biology.
T. Dale.
Sarsia, Vol. 72, No. 3/4, p 197-202, 1987. 3 fig, 3 tab, 33 ref. Norwegian Research Council for Science and the Humanities, Grant D.51.44.035.

Descriptors: *Oil pollution, *Water pollution effects, *Hydrocarbons, *Zooplankton, *Protozoa, Lindaspollene, Norway.

Two 13 m deep plastic enclosures (surface 0.78 sq m) were used to study the responses of planktonic ciliates to oil pollution during a northern phytoplankton spring bloom. The plastic bags were used to enclose naturally stratified water columns in March 1980 in Lindaspollene, Norway. One-half liter of Ekofisk crude oil was added to the surface in one bag, while the other served as a control (CB). The abundance pattern of both the heterotrophic ciliates and Mesodinium rubrum in the CB differed in several respects from that observed outside the bags. The net population growth rates for heterotrophic ciliates and M. rubrum in the CB were 0.32 and 0.63 divisions per day, respectively, at temperatures about 2-4 C. Hydrocarbon concentrations between 0.62 and 1.27 mg/l caused declining densities of heterotrophic ciliates. M. rubrum appeared to be more sensitive than the heterotrophic ciliates. After the disappearance from 0.5 m, all ciliates remained absent from this depth during the nearly 2-month duration of the experiment. (Author's abstract)
W89-03509

BIOTEST SYSTEM FOR LONG TERM EFFECT-STUDIES OF OIL ON MARINE FISH EGGS AND LARVAE: DESIGN, COMPONENT DESCRIPTION AND FUNCTIONAL TESTS,
Bergen Univ. (Norway). Zoological Lab.
H. J. Fyhn, H. Salhus, and T. N. Barnung.
Sarsia SARIA3, Vol. 72, No. 3/4, p 321-328, 1987. 5 fig, 3 tab, 9 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Toxicity, *Fish eggs, *Larvae, Laboratory equipment, Aquariums.

An automated, flow-through, multi-aquarium system with precise temperature control and dosed inputs of water soluble toxicants was built from biologically inert materials for long-term effect-studies on aquatic organisms. Although especially constructed for studies of the effect of oil (water-soluble) fraction on eggs and larvae of marine fishes, the biotest system holds the potential of testing other water-soluble toxicants on aquatic animals within a size range from 1 mg to 1 kg. In its current form, the biotest system has a capacity of about 12,000 eggs or 60,000 yolk-sac larvae of cod (Gadus morhua) divided between two test groups and one control group, each of four parallel aquaria. Special consideration was given to essential steps and components in order to maximize continuity of operation, safety, and ease of handling of the system. The long term temperature variation of the system is within 0.05 C, and the temperature difference between the experimental groups within 0.005 C. The stability of the dosage pumps is within 2%. Two days of extraction are sufficient for a partial stabilization of the stock solution which can then be used for biotest purposes for at least the following week. The stirring of the stock solution and its subsequent dilution is adequate to deliver homogeneous test water of the programmed concentrations. No loss of oil compression occurs in the pipelines between the stock solution tank and the test aquaria. (Author's abstract)
W89-03511

MESOCOSM EXPERIMENTS ON THE EFFECTS OF PRODUCED WATER DISCHARGES FROM OFFSHORE OIL PLATFORMS IN THE NORTHERN NORTH SEA,
Marine Lab., Aberdeen (Scotland).
J. C. Gamble, J. M. Davies, S. J. Hay, and F. K. Dow.
Sarsia SARIA3, Vol. 72, No. 3/4, p 383-386, 1987. 3 fig, 8 ref.

Descriptors: *Oil wastes, *Water pollution effects, *Phytoplankton, *Fish, *Larvae, *North Sea, Bacteria, Produced water, Copepods, Cod, Herring, Primary productivity, Enzymes.

The effect of 'produced water' (an oily water discharge from production platforms) on several pelagic trophic levels including fish larvae were investigated using 300 cu m columnar plastic enclosures. The produced water (at a concentration equivalent to a point 0.5-1 km downstream from the discharge point) caused an increase in bacterial biomass but had only a transient, slightly depressant, effect on the rate of primary production by phytoplankton. The most noticeable effect was on the copepod populations where considerable mortality occurred in the early naupliar stages in the treated enclosures. No increased mortality was observed in cod (Gadus morhua) or herring (Clupea harengus) larvae although in the herring an increase in the activity of the enzyme aryl hydrocarbon hydroxylase was correlated with the addition of the pollutant. Indirect food-chain effects were noticed since the reduction in the copepod numbers resulted in increased phytoplankton standing stocks and in reduced growth of the larvae. (Author's abstract)
W89-03513

FLOWTHROUGH BIOTEST SYSTEM FOR CONTINUOUS EXPOSURE OF AQUATIC ORGANISMS TO OIL HYDROCARBONS,
Fiskeridirektoratets Havforskningsinstitutt, Bergen (Norway).
T. S. Solberg, S. Tilseth, J. Klungsoyr, K. Westrheim, and K. Palmork.
Sarsia SARIA3, Vol. 72, No. 3/4, p 387-390, 1987. 2 fig, 1 tab, 6 ref. Norwegian Marine Pollution Research and Monitoring Programme, Project no. 508, and A/S Norske Shell, Contract no. 83-524.

Descriptors: *Oil pollution, *Hydrocarbons, *Water pollution effects, *Toxicity, Laboratory equipment, Aquariums, Fish eggs, Larvae.

A biotest system for continuous exposure of aquatic organisms (cod eggs and larvae) to the water-soluble fraction of oil hydrocarbons is described. A stock solution was prepared in a separate tank, diluted with clean sea water to appropriate test concentrations, and continuously transferred to the exposure aquaria. The system was cleaned every week to avoid bacterial contamination. The hydrocarbon levels of aquaria and stock solution correlated with a coefficient of 0.96. Due to evaporation on the way from the stock solution tank to the aquaria, the oil concentrations of the aquaria were 40-60% lower than expected from the dilution ratios. The test solutions also contained trace amounts of polar components which probably were oxidized compounds of oil hydrocarbon origin. These compounds could be of importance for the evaluation of eventual effects on test organisms. (Author's abstract)
W89-03514

EFFECT OF OIL-EXPOSURE ON THE OXYGEN UPTAKE OF COD (GADUS MORHUA) EGGS AND LARVAE,
Bergen Univ. (Norway). Zoological Lab.
B. Serigstad.
Sarsia SARIA3, Vol. 72, No. 3/4, p 401-403, 1987. 4 fig, 10 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Toxicity, *Fish eggs, *Larvae, Cod, Oxygen uptake.

Cod (Gadus morhua) eggs and larvae were continually exposed to water extracts of North Sea crude oils in the concentration range from 50-280 ppb of the water-soluble fraction (WSF). The oil exposure did not influence the oxygen uptake of cod eggs. Unfed larvae, however, suffered a 50% reduction in the oxygen uptake rate. The effect was independent of the oil concentration in the tested range. Larvae exposed to 230 ppb WSF for only 24 hours demonstrated the same 50% reduction in the oxygen uptake. There was no recovery in oil-exposed cod larvae after transfer to clean seawater. The oxygen uptake of control larvae measured in total darkness was of the same magnitude as for the oil-exposed larvae. Exposed larvae, measured in darkness, however, showed a further 5-10% reduction in the oxygen uptake rate. After anesthesia (MS-222, 1:20,000) the oxygen uptake of both control and oil-exposed larvae decreased 60-65% compared to control conditions at the time of final yolk absorption. (Sand-PTT)
W89-03515

CYTOCHROMES P-450 IN FISH LARVAE: IMMUNOCHEMICAL DETECTION OF RESPONSES TO OIL POLLUTION,
Bergen Univ. (Norway). Dept. of Biochemistry.
A. Goksoyr, and T. S. Solberg.
Sarsia SARIA3, Vol. 72, No. 3/4, p 405-407, 1987. 2 fig, 10 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Toxicity, *Fish, *Bioindicators, *Larvae, Fish physiology, Enzymes, Cytochrome P-450, Cod.

Rabbit antiserum against the major beta-naphthoflavone-inducible cytochrome P-450 isoenzyme purified from cod (Gadus morhua) liver was used as an immunochemical probe to detect responses of larvae to oil exposure. Cod eggs were fertilized, reared and exposed in a system allowing full control of the concentration of water-soluble compounds from crude North Sea oil. The immunochemical response in homogenates of whole larvae reflected the exposure in a dose-dependent manner. The study shows that cod larvae respond to oil exposure with induced cytochrome P-450 synthesis, and that immunochemical probes of cytochrome P-450 induction can be a valuable tool in monitoring marine pollution. (Author's abstract)

W89-03516

ACUTE TOXICITY TESTS OF THE EFFECTS OF OILS AND DISPERSANTS ON MARINE FISH EMBRYOS AND LARVAE: A REVIEW,
Tromsoe Univ. (Norway). Inst. of Fisheries.
I. B. Falk-Petersen, and E. Kjorsvik.
Sarsia SARIA3, Vol. 72, No. 3/4, p 411-413, 1987. 1 fig, 1 tab, 13 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Aromatic compounds, *Hydrocarbons, *Toxicity, *Fish, Growth stages, Embryos, Larvae.

The toxicity of various hydrocarbons and oil-related compounds varied with fish species and developmental stages tested. Generally cod embryos were most sensitive. Seawater soluble components from crude oil were less toxic than components from photooxidized and weathered oil. Single aromatic hydrocarbons varied in toxicity depending on the number and molecular position of methylated groups. Cytological studies revealed chromosomal aberrations in exposed embryos. The toxicity tests all showed that late embryonic stages were less sensitive to hydrocarbons than newly fertilized eggs. However, the variations in toxic response indicate the importance of using different species and stages of test organisms as well as different types of tests for the evaluation of a toxicant. (Author's abstract)
W89-03517

FATTY ACID PROFILE IN COD (GADUS MORHUA L.) EGGS AND LARVAE: DEVELOPMENTAL VARIATIONS AND RESPONSES TO OIL POLLUTION,
Bergen Univ. (Norway). Zoological Lab.
T. N. Barnung, and O. Grahl-Nielsen.
Sarsia SARIA3, Vol. 72, No. 3/4, p 415-417, 1987. 2 fig, 8 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Fish eggs, *Larvae, *Toxicity, Cod, Fatty acids.

The fatty acid profile was determined in single eggs and larvae of cod. By principal component analysis, the profile was shown to change during development from fertilization to hatching, and also during development of the larvae from hatching until the yolk sac is absorbed. Exposure of the eggs to 280 + or - 150 microgram/l of the water-soluble fraction of Statfjord crude oil had no apparent effect on the profile. Exposure of the larvae to 230 + or - 110 microgram/l caused an effect during final yolk absorption, manifested mainly as a slower disappearance of the polyunsaturated acid 22:6 (n-3). (Author's abstract)
W89-03518

CHLORINATED HYDROCARBON RESIDUES IN GONADS OF MARINE FISH AND EFFECTS ON REPRODUCTION,
Biologische Anstalt Helgoland (Germany, F.R.)
H. von Westernhagen, V. Dethlefsen, P. Cameron, and D. Janssen.
Sarsia SARIA3, Vol. 72, No. 3/4, p 419-422, 1987. 2 fig, 1 tab, 16 ref.

Descriptors: *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Toxicity, *Pesticide toxicity, *Water pollution effects, *Fish, Halogenated pesticides, Dieldren, DDT, Larvae.

Due to their formerly widespread use and their slow degradability, chlorinated hydrocarbons are ubiquitous in the environment and tend to accumulate in marine biota. Many of these substances, being highly toxic (pesticides), have long been suspected of exerting detrimental effects on metabolism and reproductive capacity of highly contaminated individuals. The study showed that levels of polychlorinated biphenyls (PCBs) found in ovaries of three marine teleosts correlate with a loss of reproductive capacity. Male gonads contained lower concentrations of chlorinated hydrocarbons than did ovaries; the variability in hatching success therefore seems to depend on the contamination of ovaries. Effective PCB ovary burdens were in the range of 120-180 ng/g tissue wet weight. Pesticides such as DDE and Dieldrin also seem to impair reproductive success, measured as the emergence of viable larvae from eggs of contaminated parent fish. (Author's abstract)
W89-03519

NANOPLANKTON COMMUNITIES IN HALTENBANKEN WATERS (NORWEGIAN SEA) DURING AN OIL SPILL EXPERIMENT, JULY-AUGUST 1982,
Oslo Univ. (Norway). Dept. of Biology.
J. Throndsen, and S. Kristiansen.
Sarsia, Vol. 73, No. 1, p 71-74, 1988. 5 fig, 2 tab, 11 ref.

Descriptors: *Oil pollution, *Bioindicators, *Phytoplankton, *Algae, *Water pollution effects, Norwegian Sea, Norway, Oil spills.

The nanoplankton communities were studied by means of a serial dilution culture method to reveal the presence of viable species during a 100 tonnes offshore oil spill experiment. The nanoplankton was dominated by the coccoid chrysophycean species Pelagococcus subviridis with cell numbers up to 10 million cells per liter. Other important species were Emiliania huxleyi, Micromonas pusilla and species of Pavlova, Cryptomonas, and Plagioselmis. The presence of E. huxleyi and M. pusilla indicates that there was no severe pollution effect, as these species are known to be sensitive to oil pollution. The 10-fold increase in cell numbers of P. subviridis in the range of one week in samples from polluted as well as from clean water further supports the view that the concentration of toxic substances was negligible. (Author's abstract)
W89-03520

POTENTIAL HEALTH RISK OF TRIHALOMETHANES IN DRINKING WATER: A PERSPECTIVE,
Water Research Commission, Pretoria (South Africa).
M. J. Pieterse.
South African Journal of Science, Vol. 84, No. 3, p 166-170, January 1988. 2 tab, 66 ref.

Descriptors: *Halogenated hydrocarbons, *Drinking water, *Disinfectants, *Chlorination, *Carcinogens, *Mutagens, Epidemiology, Chlorinated hydrocarbons, Trihalomethanes, Chloroform, Reviews, Water quality standards.

The associated health aspects trihalomethanes in drinking water are reviewed and the lack of consensus in this regard is emphasized. Although contradictory in some cases, available data suggest that THMs at high doses especially chloroform cause acute and chronic toxicity, and carcinogenicity in rodents. Mutagenic activity in drinking water is likely to be a product of chlorination. Although some results suggest associations between and certain cancers in humans, there are so many factors involved that these findings should be regarded as tentative. It is extremely difficult to derive a 'safe level' for drinking water from available toxicological data on THMs. Recent guidelines have been established, in certain countries, according to which norms should be set for these compounds. Risk assessment should receive high priority. A realistic approach is necessary that includes the present concentration of THMs in drinking water, the practical control of possible standards and the policy of the responsible authority regarding the establishment of norms. The efficient disinfection of water should not be compromised, and chlorination should not be phased out in preference to other methods unless there is stronger evidence that it produces serious health risks and until the potential hazards of substitute disinfectants are fully explored. (Sand-PTT)
W89-03524

PHYSICAL ENVIRONMENTAL FACTORS CONTRIBUTE TO RECURRING HYPOXIA IN THE NEW YORK BIGHT,
National Oceanic and Atmospheric Administration, Rockville, MD. Office of Oceanic and Atmospheric Research.
R. L. Swanson, and C. A. Parker.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 1, p 37-47, January 1988. 7 fig, 2 tab, 22 ref.

Descriptors: *Oxygen depletion, *Hypoxia, *Anaerobic conditions, *Dissolved oxygen, *Water pollution effects, *New York Bight, Pycnoclines, Wind.

Dissolved oxygen data obtained for the nearshores of the New York Bight during 1974-83 were analyzed statistically for relationships between physical factors and bottom dissolved oxygen concentrations (DO). A multiple linear regression expression was developed as an estimator for bottom DO both as a function of the depth of the pycnocline and as an index of wind energy and its persistence. This latter index is called the quiescence-constancy index. The estimator for DO explained 86% of the variability over the decade of analysis. The utility of the estimator was examined in the context of several years not included in the analysis. In general, deep pycnoclines and strong persistent southerly to southwesterly winds were closely correlated with low bottom DO averaged over the region. Shallow pycnoclines and strong but variable winds were associated with higher values of regionally averaged bottom DO. (Author's abstract)
W89-03525

BONE DEVELOPMENT IN CREEK CHUB FROM A STREAM CHRONICALLY POLLUTED WITH HEAVY METALS,
National Fisheries Contaminant Research Center, Yankton, SD. Field Research Station.
S. J. Hamilton, and R. J. Reash.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 1, p , January 1988. 2 fig, 2 tab, 30 ref. U.S. Army Corps of Engineers Contract DAC-W69-83-M-0698.

Descriptors: *Water pollution effects, *Heavy metals, *Toxicity, *Fish physiology, Chubs, Chromium, Copper, Iron, Nickel, Zinc, Rocky Fork, Clear Fork, Ohio.

Creek chub (Semotilus atromaculatus) from Rocky Fork, a metal-contaminated stream in north-central Ohio, and Clear Fork, a nearby uncontaminated stream, were studied to determine the effects of chronic heavy metal concentration from industrial and municipal sources on bone development. Bone development of fish from two contaminated sites in Rocky Fork and from four reference sites was examined to evaluate variability among reference sites, and to determine if the clean-water headwater site on Rocky Fork was a suitable reference site for the two downstream contaminated sites. Collagen composition, density, strength, and energy-absorbing capacity of bone were significantly higher in fish from the headwater site on Clear Fork (upstream from an impoundment) than in fish at the other three reference sites. In bones of creek chub from sites in Rocky Fork where the water contained high total concentrations of chromium, copper, iron, nickel and zinc, the collagen content of bone was lower but density and strength were higher than in bone of fish from the reference site. Some fish also had deformed vertebrae in the caudal peduncle region of the spinal column, which is a condition characteristic of neuromuscular overload of vertebrae. The high concentrations of chromium and zinc in fish from the contaminated sites probably interfered with collagen metabolism and altered the density and mechanical properties of bone. Creek chub at the contaminated sites seem to be tolerant of heavy metal contamination and may be adapting physiologically to the chronic metal stress in their environment. (Author's abstract)
W89-03526

EFFECTS OF TURBIDITY ON PREY CONSUMPTION BY STRIPED BASS LARVAE,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
D. L. Breitburg.
Transactions of the American Fisheries Society

TAFSAI, Vol. 117, No. 1, p 72-77, January 1988. 1 fig, 2 tab, 28 ref.

Descriptors: *Bass, *Larvae, *Fish food organisms, *Turbidity, *Fisheries, Copepods, Daphnia.

Striped bass (Morone saxatilis) breed in waters often affected by human activities that increase turbidity. Laboratory experiments were conducted to examine the effect of turbidity on the numbers and sizes of prey consumed by striped bass larvae during 25-min feeding trials. Larvae feeding on natural prey assemblages, primarily composed of copepods, consumed approximately 40% fewer prey in suspended solids concentrations of 200 and 500 mg/l than in 0 or 75 mg/l. In contrast, larvae feeding on Daphnia pulex captured the same average number of prey at all suspended solids concentrations tested. Turbidity also has no effect on the size of copepods or D. pulex eaten. (Author's abstract)
W89-03527

COMPARATIVE STRESS RESPONSE TO DIESEL OIL AND SALINITY CHANGES OF THE BLUE MUSSEL, MYTILUS EDULIS FROM THE BALTIC AND NORTH SEAS,
Askoe Lab., Stockholm (Sweden).
M. Tedengren, and N. Kautsky.
Ophelia OPHLAN, Vol. 28, No. 1, p 1-9, December 1987. 1 fig, 1 tab, 33 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Salinity, *Mussels, Stress, Fuel, Comparison studies, Baltic Sea, North Sea.

Due to the lower salinity, Baltic Mytilus edulis are dwarfed compared to North Sea mussels. The relative sensitivity to pollution of the two populations has been much debated. The stress response of M. edulis from the Baltic and North Seas to addition of diesel oil in combination with salinity changes was studied. Respiration and ammonium-N excretion changed synergistically with lowered salinity in Baltic Mussels but not in North Sea mussels. Stress effects were generally aggravated by simultaneous lowering of salinity and counteracted by salinity increases. A more pronounced lowering of O/N ratios of Baltic mussels at ambient salinities indicates that these are more sensitive to additional stress of oil pollution that is superimposed on the already existing salinity stress. (Author's abstract)
W89-03529

LONG-TERM SOFT-BOTTOM FAUNAL CHANGES IN THREE SHALLOW FJORDS, WEST SWEDEN,
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
For primary bibliographic entry see Field 2L.
W89-03537

EFFECT OF AGRICULTURE ON THE PRIMARY PRODUCTION IN LAKE BESKIE (POLAND) AS RECORDED IN THE STRATIGRAPHY OF FOSSIL PIGMENTS,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
M. Rybak.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 21-26, January 8, 1988. 3 fig, 40 ref.

Descriptors: *Water pollution effects, *Agricultural runoff, *Lakes, *Primary productivity, *Pollutant identification, *Palaeolimnology, Pigments, Stratigraphy, Eutrophication, Oxygen deficit, Fertilization, Catchment areas, Soil erosion, Soil absorption capacity, Poland.

Analysis of pigments deposited in the bottom sediments of Lake Beskie was used to assess past changes. Three characteristic periods of lake development were distinguished. These periods correspond with transformations in the lake's catchment area induced by the development of agriculture. A first period was characterized by intensive inflow of allochthonous matter into the lake, due to agricultural practices in the catchment area which favored soil erosion. This erosion and the subsequent increase in mineral fertilization resulted in decrease of sorption ability of the soil. This in turn led to increased leaching of nutrients into the lake which resulted in increased primary production and hypolimnetic anoxia. These high oxygen deficits were characterized by the development of photosynthetic bacteria of the genus Chlorobium, and an intensification of the lake's enrichment, mainly with phosphorus. In a final period, organic fertilizers (manure) were used in the catchment area. A noticeable improvement of sorption ability of the soil occurred, migration of nutrients to the lake was inhibited, and primary productivity decreased. (Author's abstract)
W89-03540

GROWTH IN A FRESHWATER SNAIL UNDER LABORATORY CONDITIONS IN RELATION TO EUTROPHICATION,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
J. Dorgelo.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 125-127, January 18, 1988. 2 fig, 13 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Aquatic animals, *Snails, *Animal growth, Mesotrophic lakes, Oligotrophic lakes, Eutrophic lakes, Growth rates, The Netherlands.

Shell growth in the snail Potamopyrgus jenkinsi (Prosobranchia, Hydrobiidae) was measured under laboratory conditions. Juveniles of this snail, a grazer, were collected from sandy bottoms in the meso-oligotrophic Lake Maarsseveen I (maximum production per day 500 mg C/sq m) and the eutrophic Lake Maarsseveen II (8125 mg C/sq m). These man-made lakes, centrally located in The Netherlands, are more than 20 m deep, and stratify in summer. Individuals of populations from the two lakes were kept in water with sandy substrates from each environment. Growth was faster in the environment of the more eutrophic lake, regardless of the origin of the snails; in particular, this held for the smallest size class. (Shidler-PTT)
W89-03548

NUISANCE BIOMASS LEVELS OF PERIPHYTIC ALGAE IN STREAMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, J. M. Jacoby, R. R. Horner, and M. R. Seeley.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 161-168, January 18, 1988. 4 fig, 3 tab, 21 ref. NSF grant CEE-8304731.

Descriptors: *Water pollution effects, *Stream biota, *Aquatic plants, *Epiphytes, *Nuisance algae, *Phosphorus, *Biomass, Chlorophyll a, Aesthetics, Dissolved oxygen, Limiting nutrients.

Relative coverage of filamentous periphytic algae increased with chlorophyll-a biomass on natural substrata in 22 northwestern United States and Swedish streams. A biomass range of 100-150 mg chlorophyll a/square m may represent a critical level for an aesthetic nuisance; below those levels, filamentous coverage was 10%. Other indices of water quality (dissolved oxygen content and measures of benthic macroinvertebrate diversity) were apparently unaffected by periphytic biomass or filamentous coverage in these streams. Neither was biomass related to limiting-nutrient content (soluble reactive phosphorus, SRP), as has been observed in previous experiments using bare rocks in streams and slides in artificial channels. Ambient SRP concentration may not be a useful predictor of periphyton accrual on natural substrates, due to uptake and recycling of P throughout the stream and undetermined losses such as sloughing and grazing. (Author's abstract)
W89-03549

EFFECT OF CHRONIC EXPOSURE TO CADMIUM AND COPPER ON ASELLUS AQUATICUS (L.) (CRUSTACEA, ISOPODA),
Naples Univ. (Italy). Dipt. Genetica, Biologia Generale e Molecolare.
M. de Nicola Giudici, L. Migliore, C. Gambardella, and A. Marotta.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 265-269, January 22, 1988. 2 tab, 11 ref.

Descriptors: *Water pollution effects, *Toxicity, *Cadmium, *Copper, *Isopods, Crustaceans, Survival, Animal growth, Growth rates, Embryonic growth stage, Juvenile growth stage, Life cycles, Ecological effects.

The effects of 5 microg/L cadmium or copper on Asellus aquaticus were studied by analyzing survival and body growth in the first stages of the life cycle and by determining fecundity and survival of embryo-bearing females. Juvenile survival was differently affected by the two metals in that embryonic development was more sensitive to cadmium while juvenile development was more sensitive to copper. Juvenile body growth was stimulated by cadmium and depressed by copper. Embryo-bearing female survival and fecundity were significantly reduced by cadmium but were not affected by copper. The results indicate a higher toxicity of cadmium, in that female and juvenile survival and fecundity were dramatically reduced. Copper did not affect female survival and fecundity, but had a very harmful effect on juvenile survival and growth rate. It can be argued that at the same low concentration both cadmium and copper, even though having different toxicities, action mechanism, and targets, lead to the same result, i.e., when exposed to 5 microg/L of either, Asellus populations are unable to survive. Hence, from an ecological point of view it appears more and more important to take into account the long-term effects of a pollutant on populations study the demographic parameters involved to establish the maximum permissible concentration in the environment. (Shidler-PTT)
W89-03554

CHANGES IN THE ABUNDANCE OF BLUE-GREEN ALGAE RELATED TO NUTRIENT LOADINGS IN THE NEARSHORE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang, and R. Rossmann.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 271-278, January 22, 1988. 5 fig, 25 ref.

Descriptors: *Water pollution control, *Lake Michigan, *Nearshore processes, *Eutrophication, *Nutrients, *Aquatic populations, *Cyanophyta, Influent streams, Thermal stratification, Phosphorus, Silica.

The dynamics of eutrophication in large lakes can produce significant inshore/offshore differences. Significant decreases in river loadings of nutrients have reduced their supply to the nearshore of southeastern Lake Michigan. This reduction can affect the nutrient supply and result in biological changes. It corresponds to sharp increases in the abundance of blue-green algae in this region of Lake Michigan after thermal stratification, particularly Anacystis incerta and Gomphosphaeria lacustris. Phosphorus-stimulated low dissolved-silica concentrations and phosphorus limitation after stratification are the primary factors contributing to the success of these algae. (Shidler-PTT)
W89-03555

EFFECTS OF PERMETHRIN ON PHYTOPLANKTON AND ZOOPLANKTON IN AN ENCLOSURE ECOSYSTEM IN A POND,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
M. Yasuno, T. Hanazato, T. Iwakuma, K. Takamura, and R. Ueno.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 247-258, March 22, 1988. 9 fig, 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Ponds, *Insecticides, *Plankton, *Hazardous materials, *Mesocosms, Sediment-water interfaces, Daphnia, Predation, Population dynamics, Waterfleas, Rotifers, Photosynthesis, Chrysophyta.

The insecticide permethrin (a synthetic pyrethroid) was applied in enclosures 1 m in diameter and 3.5 m deep. The chemical was rapidly removed from the water to the sediments. Daphnia rosea and its predator, Chaoborus flavicans were seriously affected by this application and disappeared from the enclosure. Acanthodiaptomus pacificus increased as Chaoborus decreased. Two species of Cladocera which had not been observed before the treatment established their populations after 10 days, when Chaoborus had not recovered. Whereas Tropocyclops pracinus declined when permethrin was applied at 10 microg/L, the numbers of the rotifer Keratella valga increased, suggesting a close relationship between these two species. Photosynthesis and phytoplankton were not significantly affected by permethrin, except for Ceratium hirundinella. The dominance of Dinobryon divergens continued in the treated enclosures, whereas other flagellate species, Scenedesmus, and Nitzschia occurred during the second half of the experiments in the control enclosure and pond. (Author's abstract)
W89-03566

EXPERIMENTAL MEASUREMENT OF RESOURCE COMPETITION BETWEEN PLANKTONIC MICROALGAE AND MACROALGAE (SEAWEEDS) IN MESOCOSMS SIMULATING THE SAN FRANCISCO BAY-ESTUARY, CALIFORNIA,
CH2M Hill, Emeryville, CA.
D. W. Smith, and A. J. Horne.
Hydrobiologia HYDRB8, Vol. 159, No. 3, p 259-268, March 22, 1988. 3 fig, 2 tab, 45 ref.

Descriptors: *Water pollution effects, *Estuarine environment, *Phytoplankton, *Algae, *Mesocosms, *San Francisco Bay, California, Bioassay, Brackish water, Saline-freshwater interfaces, Nutrients, Wastewater outfall, Population density, Diatoms, Wastewater disposal, Growth rates, Nitrogen, Nutrient removal, Nutrient requirements.

Planktonic algae are not abundant in the brackish waters of San Francisco Bay/Estuary, despite the high level of nutrients usually present due to the input of treated sewage from 3 million people. Seaweeds are sometimes locally abundant in the Bay. Phytoplankton are abundant and seaweeds uncommon in the almost-freshwater Delta and upper Estuary despite lower nutrient levels. Direct competition between these algal groups could explain the observed distributions. Experiments were carried out in flow-through mesocosms (analog tanks) of 3 cu m volume. The macroalgae Ulva lactuca and a diatom-dominated phytoplankton, all from San Francisco Bay, were grown separately and together and with and without treated sewage effluent or other artificial nutrient additions. When grown alone phytoplankton and macroalgae were greatly stimulated by wastewater addition to unmodified bay water. The phytoplankton grew much more slowly in the presence of natural densities of Ulva. Resource competition for inorganic nitrogen was determined to be the probable cause of the depression of phytoplankton by Ulva. At its rapid growth rates (up to 14%/day) this macroalga reduced inorganic nitrogen to low levels. Ulva has a greater affinity for nitrogen than do some of the plankton of the Bay. Ulva may outcompete phytoplankton by reducing nitrogen to levels below those capable of supporting phytoplankton growth. (Author's abstract)
W89-03567

EFFECTS OF HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER ON THE DISTRIBUTION OF AQUATIC MACROINVERTEBRATES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. A. Roline.
Hydrobiologia HYDRB8, Vol. 160, No. 1, p 3-8, March 8, 1988. 4 fig, 17 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Arkansas River, *Aquatic animals, *Macroinvertebrates, *Ecological distribution, Water quality, Water pollution sources, Benthic fauna, Aquatic insects, Species diversity, Hydrogen ion concentration, Flow discharge, Colorado.

A 2-year study of water quality and types and diversity of aquatic macroinvertebrates in a 30-km section of the river in Colorado show that heavy-metal pollution of the upper Arkansas River is presently moderately severe and conditions for aquatic life are generally poor, particularly in the Leadville area. Physical and chemical water parameters were measured, and macroinvertebrates were collected. The major sources of heavy-metal-laden inflows are Leadville Drain, California Gulch, and a number of intermittent flows entering the Arkansas River between Lake Fork and Lake Creek. Water temperature generally increased downstream as well as throughout the summer. The pH was slightly alkaline, averaging 8.0, and was generally slightly higher during the late summer and fall when primary production was greatest. Discharge varied greatly during the year with spring runoff accounting for most of the variation. Mean concentrations of most heavy metals were usually in excess of recommended limits, particularly at all stations downstream of the Leadville Drain inflow. Average diversity indices throughout the study period showed that community structure changed downstream from the heavy-metals pollution sources. Aquatic insects from the orders Diptera (flies), Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) constituted the majority of the organisms collected during the study. (Shidler-PTT)
W89-03571

ACID STRESS AND LAKE BACTERIA: ULTRASTRUCTURAL AND PHYSIOLOGICAL CORRELATES OF SOME ACID AND COPPER STRESSES,
National Water Research Inst., Burlington (Ontario).
G. G. Leppard, and S. S. Rao.
Hydrobiologia HYDRB8, Vol. 160, No. 2, p 241-247, March 22, 1988. 3 fig, 2 tab, 27 ref.

Descriptors: *Acid rain, *Acid water, *Copper, *Lakes, *Bacteria, *Bacterial physiology, Ecosystems, Metabolism, Electron microscopy, Hydrogen ion concentration, Aquatic populations, Adaptation, Enzymes.

Acid rainfall in the pH range of 4.0 to 4.5 has become a common event and one which is deleterious to many aquatic ecosystems. The feasibility of using cytological features of natural bacterial populations as indicators of adaptations and metabolic lesions produced by various acid stresses on lakes was studied by transmission electron microscopy (TEM) of ultrathin sections of indigenous samples and of enrichment cultures (grown at the corresponding pH of the fresh samples). Gram-negative bacteria of simple morphology were the major contributors to microbial biomass; among the 'cell compartments' of these Gram-negative bacteria, the cell envelope and its extracellular extensions showed changes which correlated roughly with the degree of acid stress. No unusual relations with the inner (peptidoglycan) wall layer were noted with acid stress alone, but the situation changed upon addition of copper. This copper-induced change was the presence of an inclusion between the cell membrane and the inner wall layer. Low acid stress, high acid stress, high acid/copper stress, and the presence of copper at minimal acid stress can be differentiated by a TEM examination. For the dominant morphotypes of Gram-negative bacteria, changes in the cell envelope (and its extensions) correlate also with changes in activity of envelope-associated enzymes. (Shidler-PTT)
W89-03575

COMPARISON OF PERIPHYTON COMMUNITY STRUCTURAL AND FUNCTIONAL RESPONSES TO HEAVY METALS,
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
For primary bibliographic entry see Field 5A.
W89-03579

LAKE KINNERET PHYTOPLANKTON: RESPONSE TO N AND P ENRICHMENTS IN EXPERIMENTS AND IN NATURE,
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W89-03591

PREPRINTS OF PAPERS PRESENTED AT THE 196TH ACS NATIONAL MEETING.
For primary bibliographic entry see Field 5B.
W89-03595

RISK DUE TO RADIONUCLIDES IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Solid Waste Management Programs.
C. R. Cothern, and P. Milvy.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 149-150. 1 tab.

Descriptors: *Radioisotopes, *Drinking water, *Risks, *Human diseases, *Water pollution effects, Uranium, Strontium, Radium, Uranium, Radionuclides.

Estimates of risk due to radionuclides in drinking water require knowledge of occurrence and dose-response relationships for humans. Using information presented at a workshop (published as the May 1985 issue of Health Physics) and more recent additional information, the risk due to radionuclides in drinking water has been evaluated. The estimated annual population risks (the number of fatalities per year in the United States) are: (1) 226Ra - 3 to 60 excess cases, (2) 228Ra - 3 to 60 excess cases, (3) natural uranium - 1 to 10 excess cases, (4) 222Ra - 80 to 800 excess cases, and (5) 90Sr - 0.2 to 1 excess cases. (See also W89-03595) (Author's abstract)
W89-03606

LIVER STRUCTURAL ALTERATIONS ACCOMPANYING CHRONIC TOXICITY IN FISHES: POTENTIAL BIOMARKERS OF EXPOSURE.
California Univ., Davis. School of Medicine.
D. E. Hinton, D. J. Lauren, T. L. Holliday, and C. S. Giam.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 233-235. 24 ref. National Cancer Institute grant CA45131 and National Institute of Environmental Health Sciences grant ESO4699-01.

Descriptors: *Fish diseases, *Carcinogens, *Toxicity, *Water pollution effects, Liver, Population exposure, Bioindicators, Sublethal effects, Fish.

Laboratory exposure of fish to reference carcinogens and field investigations of fish from polluted sites indicate the involvement of liver in chronic toxicity. Tissue lesions include neoplastic and inflammatory responses while hepatocellular alterations signal lethal as well as sublethal cellular changes. Recent investigations on histogenesis of chronic toxicity in laboratory studies and extensive examination of feral fishes from impacted sites show similar lesions including apoptosis, spongiosis hepatis, karyocytomegaly of hepatocytes, peribiliary spongiotic edema, and, in specific instances, neoplasms of liver. The application of this spectrum of hepatic alterations as biomarkers for field investigations is proposed. (See also W89-03595) (Author's abstract)
W89-03621

HISTOPATHOLOGY OF ATLANTIC TOMCOD: A POSSIBLE MONITOR OF XENOBIOTICS IN NORTHEAST TIDAL RIVERS AND ESTUARIES,
Louisville Univ., KY.
S. M. Cormier, and R. N. Racine.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 236-239. 3 fig, 5 ref.

Descriptors: *Fish disease, *Histology, *Carcinogens, *Water pollution effects, *Toxicity, Tomcod, Etiology, Hudson River, Saco River, Pawcatuck River, Rivers, Liver, Fish.

More than 500 Atlantic tomcod Microgadus tomcod, were evaluated for gross and histological evidence of hepatocellular carcinoma. Atlantic tomcod, inhabiting tidal rivers of the Northeast United States, appear to exhibit differential levels of liver disease that may be associated with xenobiotics. Populations of tomcod from the Hudson River have exhibited a very high incidence of hepatocellular carcinoma while less impacted rivers, such as the Pawcatuck River, Rhode Island and the Saco River, Maine were much lower. A comparative study of liver histology from the Pawcatuck River and the Hudson River indicated that in the adult tomcod from the Hudson population, hepatic function was compromised by fatty infiltration, basophilic foci, areas of cellular alteration, and hepatocellular carcinoma. Hepatic lipid levels from the Hudson River (36.3%) were significantly elevated over those from Pawcatuck River tomcod (11.0%), as quantified by morphometric analyses of plastic sections of livers. An etiology involving xenobiotics is highly suspect for these effects since it is known that elevated detoxification of some organics results in increased hepatic lipid levels. (See also W89-03595) (Miller-PTT)
W89-03622

CROAKER (NIBEA MITSUKURII) AND THE SEA CATFISH (PLOTOSUS ANGUILLARIS) MAY BE CONSIDERED AS USEFUL BIOMARKERS OF COASTAL POLLUTION,
Shizuoka Univ. (Japan). Lab. of Food Hygiene.
M. Yamashita, N. Kinae, I. Kimura, H. Ishida, and H. Kumai.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 241-244. 2 fig, 4 tab, 2 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Fish disease, *Coastal waters, *Effluents, Estimating, Fish, Croaker, Catfish, Pulp wastes, Carcinogens.

The possibility of using croaker and sea catfish species as biomarkers in the aquatic environment which is contaminated with chemical substances is reported. The chromatophoroma in the croaker showed unique geographic distribution in the Pacific coast of Japan. The average tumor incidence at station A was about 47% in 1973-1981. Skin pigment cell hyperplasia in the sea catfish was found in the same area at incidence of 14% in 1979-1981. The incidence of these skin diseases gradually decreased in recent years. The decrease appears to have resulted from improvement of the treatment plant effluent which is mainly discharged from a kraft pulp mill into the coastal area. Both fish diseases were induced in the laboratory by administration of the pulp mill effluent as well as known carcinogens such as 7,12-dimethylbenzo(a)-anthracene, N-methyl-N'-nitro-N-nitrosoguanidine and 6-hydroxymethyl-2-(2-(5-nitro-2-furyl)vinyl)pyridine. From the above results, the croaker and the sea catfish may be useful biomarkers for the estimation of coastal water qualities. (See also W89-03595) (Miller-PTT)
W89-03623

MACROPHAGE RESPONSES OF ESTUARINE FISH AS BIOINDICATORS OF TOXIC CONTAMINATION,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5A.
W89-03624

IDENTIFICATION AND APPLICATION OF PHYSIO-CHEMICAL MARKERS TO DEMONSTRATE BIOLOGICAL RESPONSE,
Maryland Dept. of Natural Resources, Oxford, MD.
E. B. May.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 251-253. 2 fig.

Descriptors: *Metals, *Organic compounds, *Toxicity, Physicochemical properties, *Water pollution effects, *Fish, Finfish, Physicochemical properties.

A range of disciplines and technologies are being applied to demonstrate biological response to natural and anthropogenic changes in habitats. Of key concern are toxics (metals and organics) and methods to relate biochemical, morphological, physiological, behavioral, and population dynamics data to contaminants. Examples where the above data sets relate to one another and how such information provide strong correlations to toxics present in the environment is discussed. The examples also serve to demonstrate scenerios for monitoring toxic effects using physio-chemical markers. Data generated can provide explanations for observed toxic-related changes involving the morphology, physiology and behavior of finfish. (See also W89-03595) (Author's abstract)
W89-03625

USE OF BIOENERGETIC MEASUREMENTS FOR DETECTING SUBLETHAL POLLUTANT-INDUCED STRESS IN AQUATIC ORGANISMS,
Battelle Ocean Sciences, Duxbury, MA.
For primary bibliographic entry see Field 5A.
W89-03626

INTESTINAL NUTRIENT ABSORPTION - A BIOMARKER FOR DELETERIOUS HEAVY METALS IN AQUATIC ENVIRONMENTS,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W89-03627

LIVER CYTOCHROME P-450E LEVELS ASSOCIATED WITH CHLOROBIPHENYL RESIDUES IN STARRY FLOUNDER FROM SAN FRANCISCO BAY,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. J. Stegeman, B. R. Woodin, D. W. Rice, L. Susani, and R. B. Spies.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 261-263. 1 tab, 9 ref. NOAA contract 50ABNC-700089.

Descriptors: *Toxic wastes, *Fish physiology, *Flounders, *Polychlorinated biphenyls, *San Francisco Bay, *Water pollution effects, Hydrocarbons, Western Blot Assay, Bioindicators, Fish diseases, Liver.

Relationships between levels of P-450E, which is induced in fish by polycyclic aromatic hydrocarbons or polychlorinated biphenyls, and environmental chemicals in fish were evaluated. Catalytic assay and Western blot analysis (with monoclonal antibody 1-12-3) showed that a counterpart to P-450E is a beta-napthoflavone-inducible ethoxyresorufin O-deethylase catalyst in starry flounder (Platichthys stellatus). P-450E levels in groups of flounder from five sites around San Francisco Bay correlated positively with total polychlorinated biphenyl content in liver. Stronger correlation was seen between P-450E levels and congeners known as mixed type inducers in mammals. Ethoxyresorufin O-deethylase activity correlated less well with polychlorinated biphenyl levels, suggesting that some factors can influence catalytic function but not the levels of P-450E. The results show that P-450E levels detected immunochemically can disclose a sensitive biological change, accurately reflecting the degree of environmental contamination by some chemicals. Although strongly suggestive, the results do not require that polychlorinated biphenyls are the causative agents of induction; compounds co-varying with polychlorinated biphenyl residues could be the active inducers. (See also W89-03595) (Miller-PTT)
W89-03628

METALLOTHIONEIN AS A BIOMARKER OF ENVIRONMENTAL METAL EXPOSURE: SPECIES-DEPENDENT EFFECTS,
Northeast Louisiana Univ., Monroe. Toxicology Program.
For primary bibliographic entry see Field 5A.
W89-03629

METAL-BINDING PROTEINS FOR THE DETECTION OF HEAVY METALS IN AQUATIC ORGANISMS,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-03630

INVESTIGATIONS INTO THE POSSIBLE USES OF MARINE FLATFISH METALLATHIONEIN CONCENTRATIONS AS AN INDICATOR OF TOXIC METAL EXPOSURE,
Institute of Marine Biochemistry, Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W89-03631

CARCINOGENICITY AND DNA BINDING OF BENZO(A)PYRENE AND 7,12-DIMETHYLBENZ(A)ANTHRACENE IN RAINBOW TROUT BY CONTROLLED LABORATORY EXPOSURE,
Oregon State Univ., Corvallis. Dept. of Food Science and Technology.
A. T. Fong, J. D. Hendricks, and G. S. Bailey.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 290-291.

Descriptors: *Toxic wastes, *Carcinogens, *Trout, *Fish diseases, *Population exposure, *Hydrocarbons, *Water pollution effects, Deoxyribonucleic acid, Benzopyrenes, Aromatic compounds, Stages.

The carcinogenicity and deoxyribonucleic acid binding of benzo(a)pyrene and 7,12-dimethylbenz(a)anthracene in the rainbow trout were studied by controlled laboratory exposure. Two parameters which may influence tumor response to polycyclic aromatic hydrocarbons were examined: (1) route of exposure, and (2) life stage at exposure. Although rainbow trout seldom inhabit polluted environments where fish tumor epizootics occur, this extensively studied fish species provides a useful model for examining the carcinogenic effects of environmental contamination because they have been shown to be highly sensitive to the carcinogenic effects of alfatoxin B1 and more than 20 other carcinogens. Liver tumors were induced by long term dietary or ip administration of benzo(a)pyrene. Gill uptake was an effective route of administration for inducing tumors by 7,12-dimethylbenz(a)anthracene. In addition to liver tumors, stomach and swim bladder were major sites of tumor formation in fish exposed to 7,12-dimethylbenz(a)anthracene. Trout embryos were sensitive to the carcinogenic actions of the benzo(a)pyrene and 7,12-dimethylbenz(a)anthracene by either direct injection or by exposure to aqueous solutions of polycyclic aromatic hydrocarbons. Covalent binding of 7,12-dimethylbenz(a)anthracene metabolites to deoxyribonucleic acid was found in studies using isolated hepatocytes and embryos. The results of this study show that the trout is sensitive to the carcinogenic effects of polycyclic aromatic hydrocarbons at embryo, fry and juvenile life stages and that tumor response and site of tumor formation depend on the polycyclic aromatic hydrocarbon, the dose, and the route of administration. (See also W89-03595) (Miller-PTT)
W89-03632

CHARACTERIZATION OF C-KI-RAS ONCOGENES IN LIVER NEOPLASMS OF WINTER FLOUNDER FROM BOSTON HARBOR,
Massachusetts Inst. of Tech., Cambridge. Dept. of Applied Biological Sciences.
For primary bibliographic entry see Field 5A.
W89-03633

EVALUATION OF CANDIDATE MEASURES OF BIOLOGICAL EFFECTS FOR THE NATIONAL STATUS AND TRENDS PROGRAM,
National Ocean Service, Seattle, WA. Ocean Assessments Div.
For primary bibliographic entry see Field 5A.
W89-03634

ANALYSIS OF MUSKRAT POPULATIONS FOR BIOINDICATORS OF EXPOSURE TO CONTAMINANTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 5A.
W89-03635

SUBLETHAL EXPOSURE OF EXTRACTED SEDIMENTS INDUCES HEPATIC CELLULAR ALTERATIONS IN MEDAKI, ORYZIAS LATIPES: AN ASSAY FOR TESTING THE PRESENCE OF CARCINOGENS,
Louisville Univ., KY. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-03636

IMPACTS OF TREATED MUNICIPAL WASTEWATERS ON EARLY LIFE STAGES OF FISHES,
New Jersey Medical School, Newark. Dept. of Anatomy.
P. Weis, J. S. Weis, and A. Greenberg.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 322-325. 3 fig. NOAA grant NA85AA-D-SG084.

Descriptors: *Wastewater pollution, *Chlorination, *Wastewater treatment, *Toxicity, *Municipal wastewater, *Effluents, *Fish diseases, *Estuaries, Mummichog, Flounders, Embryonic growth stage, Juvenile growth stage, Larval growth stage, Hudson Estuary, Raritan Estuary, Bass, Chemical analysis, Flounders.

The impacts of chlorinated effluents from municipal wastewater treatment facilities on the sensitive early life stages of three fish common to the Hudson-Raritan Estuary were studied. Batch-to-batch variability in the chemistry of the effluents was reflected in biological impact. Embryos of the mummichog (Fundulus heteroclitus) might survive >50% or <10% effluent. Effects of a moderately toxic batch included cardiovascular and skeletal defects, depression of heart rate, and poor hatch. Embryos of the winter flounder (Pseudopleuronectes americanus) had decreased hatch, skeletal defects, and decreased larval growth. Growth of juveniles, as determined by a fin regeneration assay, was depressed at concentrations < or = 10% by all three batches assayed with striped bass (Morone saxatilis), one of two batches tested with mummichog, and not at all by one batch tested with winter flounder. (See also W89-03595) (Miller-PTT)
W89-03637

DNA-ADDUCTS IN FISH EXPOSED TO ALKYLATING CARCINOGENS,
Texas A and M Univ. at Galveston. Dept. of Marine Sciences.
C. S. Giam, J. L. Williams, A. Bahnson, T. L. Holliday, and R. Weller.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 337-340. 25 ref.

Descriptors: *Carcinogens, *Water pollution effects, *Trace levels, Fish disease, Deoxyribonucleic acid, Fish, Trout Chemical analysis, Mass spectrometry.

Rainbow trout (Salmo gairdneri) were exposed by ip injection of a single dose of the potent mammalian carcinogen diethylnitrosoamine (DEN). After different time intervals, the hydrolysates of their hepatic deoxyribonucleic acid were analyzed for picomole quantities of acid hydrolysates. This ethylated base was not found in the unexposed control fish. Fourier transform ion cyclotron resonance mass spectrometry was helpful in characterizing the ultra-trace amounts of this base as well as the nucleosides and nucleotides. Excretion of DEN was rapid and high (as high as 80% within 24 hrs). (See also W89-03595) (Miller-PTT)
W89-03638

FORMATION AND PERSISTENCE OF DNA ADDUCTS IN LIVER AND KIDNEY OF BROWN BULLHEADS EXPOSED TO BENZO(A)PYRENE (BP),
State Univ. of New York Coll. at Buffalo. Great Lakes Lab.
H. C. Sikka, C. Kandaswami, J. P. Rutkowski, K. Earley, and R. C. Gupta.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 355-356. 8 ref. EPA grants R-813799 and CR-813840.

Descriptors: *Toxic wastes, *Benzopyrenes, *Carcinogens, *Liver, *Kidney, *Bullhead, *Water pollution effects, Deoxyribonucleic acid, Fish, Fish disease, Population exposure, Aromatic compounds, Hydrocarbons.

The formation and persistance of benzo(a)pyrene-deoxyribonucleic acid adducts in the liver and kidney of brown bullhead (Ictalurus nebulosus), a fish species susceptible to the carcinogenic action of polynuclear aromatic hydrocarbons was investigated. Using P32-postlabeling procedure, benzo(a)pyrene-deoxyribonucleic acid adducts in liver and kidney of the fish of the fish were analyzed at various times after treatment with benzo(a)pyrene. The formation of the hydrocarbon-deoxyribonucleic acid adducts in liver proceeded very slowly up to 7 days after treatment. Following this lag, there was a rapid increase in the level of the deoxyribonucleic acid adducts with the maximum binding noticed after treatment. Subsequently, a substantial decline in the level of benzo(a)pyrene-deoxyribonucleic acid adducts occurred. After 42 days of treatment, the total adduct level in liver deoxyribonucleic acid had decreased to 32% of the maximum adduct level. The general trend for the formation and persistance of the benzo(a)pyrene-deoxyribonucleic acid adducts in kidney was similar to that noticed with liver except that the maximum deoxyribonucleic acid adduct formation occurred 12-15 days after treatment and the rate of adduct removal was slower. The predominant adduct (about 85%) in both liver and kidney deoxyribonucleic acid was tentatively identified as benzo(a)pyrene-7,8-dihydrodiol-9,10-epoxide-deoxyguanosine. (See also W89-03595) (Author's abstract)
W89-03639

ANALYSIS OF BLOOD BIOMARKERS FROM BLUEGILL SUNFISH,
Western Carolina Univ., Cullowhee, NC.
For primary bibliographic entry see Field 5A.
W89-03640

PARTS-PER-TRILLION LEVELS OF POLYCHLORINATED DIBENZOFURANS FOUND IN THE EDIBLE PORTION OF SELECTED FISH,
Food and Drug Administration, Washington, DC. Contaminants Chemistry Div.
For primary bibliographic entry see Field 5B.
W89-03649

ASSESSMENT OF HEALTH RISK FROM LITHOGENIC MERCURY,
Portland State Univ., OR.
D. A. Dunnette.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 397-399.

Descriptors: *Risks, *Mercury, *Sediment, *Fish, *Path of pollutants, *Water pollution effects, *Model studies, *Population exposure, Lithogenic mercury, Human diseases.

Potential health risks to individuals consuming unusually large quantities of fish with lithogenic mercury were investigated. Exposure assessment involved an evaluation of mercury production concentrations and dynamics in Oregon water, sediment and fish. Risk was characterized by integrating available dose-response information. Results suggest that the anthropogenic source model may not be appropriate for evaluating exposure from lithogenic sources. (See also W89-03595) (Miller-PTT)
W89-03650

ROBUST BAYES MODELS OF FISH RESPONSE TO LAKE ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 61-72, 2 tab, 25 ref. US EPA Contract CR-811837-01-0.

Descriptors: *Systems analysis, *Water chemistry, *Acid rain effects, *Limnology, *Acid rain, *Lakes, *Model studies, *Fish, *Policy making, Chemical properties, Rainfall, Precipitation, Trout, Administrative decisions, Regression analysis.

A large historical data set from the Adirondack region of the United States was created to study the relationship between water chemistry variables associated with acid precipitation and the presence/absence of selected fish species. From these data, logistic function models for presence/absence were fitted for brook trout and lake trout, using maximum likelihood and robust Bayes methods. The robust Bayes procedure used herein is a compromise estimator between Bayes and empirical Bayes, with the final expression based on classical risk function criteria. A cross-validation study will be used to aid in selection of a preferred model for policy analysis. (See also W89-03679) (Author's abstract)
W89-03686

DECISION SUPPORT SYSTEM FOR SELECTING EUTROPHICATION CONTROL STRATEGIES,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 6A.
W89-03701

INTERVENTION ANALYSIS TO ESTIMATE PHOSPHORUS LOADING SHIFTS,
Soap and Detergent Association, New York.
For primary bibliographic entry see Field 6A.
W89-03708

SENSITIVITY OF N2-FIXING BLUE-GREEN ALGAE IN COMPETITION FOR GROWTH PREREQUISITES,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Hydrology and Water Resources Engineering.
O. Varis.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 339-342, 3 fig, 4 ref.

Descriptors: *Eutrophication, *Model studies, *Cyanophyta, *Nutrients, *System analysis, *Algae, Growth, Seasonal variation, Water quality, Nitrogen, Phosphorus, Ecology, Temperature, Water temperature, Physical properties, Biomass, Nitrogen fixation.

The algal dynamics of Lake Kuortaneenjarvi, Finland were investigated. Nitrogen-fixing blue-green algal blooms in late summer account for the main water quality problems of the lake. Data were collected for one year and a lumped parameter model was constructed with special emphasis on nitrogen, phosphorus, and algal dynamics. The model was then used to analyze competition prerequisites of blue-green algae with respect to nitrogen, phosphorus, water temperature, and irradiance. The model was found to behave in a logical

manner, and the outcome was consistent with theoretical and experimental ecological knowledge. Nitrogen was found to predominate over phosphorus as a growth-limiting nutrient in summer. Increase in nitrogen load caused a decline in the biomass of blue-green algae, especially when nitrogen load was low. The competition prerequisites of nitrogen fixers were diminished by the decrease in the importance of nitrogen as a limiting factor and by a great biomass of other algae competing for the same resources. It is concluded that the modeling and perturbation approach used, even if suffering from uncertainty, is suitable for analyses of badly defined systems and their models. (See also W89-03679) (Doria-PTT)
W89-03713

PATHOGEN RISK ASSESSMENT FEASIBILITY STUDY.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-191440. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/6-88/003, March 1988. 225p, 8 fig, 38 tab, 133 ref, 2 append.

Descriptors: *Model studies, *Water pollution effects, *Sludge disposal, *Wastewater treatment, *Risks, *Pathogens, Sludge digestion, Protozoa, Fungi, Viruses, Bacteria, Lime, Temperature, Hydrogen ion concentration.

An investigation was conducted to determine whether a risk assessment is feasible for the health effects of exposure to pathogens in sludge. The study advances the view that sufficient data exist and models are available to handle the data. Varying quantities and qualities of data are available for a limited number of pathogen species in order to conduct a microbiological risk assessment. The kinds and concentrations of pathogenic bacteria, viruses, helminths, protozoa and fungi have been documented in the literature for sewage and sludges. Concentrations range from 10 to the 6th to 10 to the 8th/g dry weight for fecal indicator bacteria to 100 to 100,000 for other bacteria, viruses and parasites. Studies on the effects of anaerobic digestion, aerobic digestion, composting and lime stabilization treatment processes revealed reductions in concentrations of pathogens of 0.5-4 orders of magnitude. Composting has dramatic reductions of 2 to >4 orders of magnitude for bacteria, viruses and parasites. By contrast, lime stabilization treatment reduces bacteria by 0.5-4 orders, by >4 orders of magnitude for viruses and by <0.5 orders of magnitude for parasites. At all disposal sites, pathogen concentrations may be reduced by dilution, temperature, moisture, sunlight, pH and presence of antagonistic organisms. Five major pathways from disposal site to exposure sites (surface water, groundwater, soil/sediments, food, and aerosols/particulates) are presented in a 14-compartment pathway model and are described in considerable detail in the text. The Seattle model and the Sandia model can track pathogens through some of the pathways mentioned in conclusion 5 and to some extent describe the influence of environmental variables on pathogen concentrations. The Seattle model is simple mathematically and is designed to utilize the existing database. The Sandia model is more complex and requires more data than presently available. These models can be improved by adding transport functions to the Seattle model or eliminating parts of the Sandia model and thus simplifying it. (Lantz-PTT)
W89-03746

WATER QUALITY CRITERIA FOR COLORED SMOKES: SOLVENT GREEN 3,
Oak Ridge National Lab., TN. Health and Safety Research Div.
K. A. Davidson, and P. S. Hovatter.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003303. Price codes: A04 in paper copy, A01 in microfiche. Report No. ORNL-6409, December 1987. 100p, 3 fig, 10 tab, 78 ref, 2 append. DOE Contract DE-AC05-84OR21400. Army Project 86PP6810.

Descriptors: *Water pollution effects, *Smoke, *Solvents, *Toxicity, *Dyes, Aquatic environment, Fish, Lethal limits, Trout, Invertebrates, Algae.

Solvent Green 3 is an anthraquinone dye used by the military in M18 green smoke grenades. Solvent Green 3, also known as D and C No. 6 is certified and approved for use in contact lenses and externally applied drugs and cosmetics. The environmental release of Solvent Green 3 may occur during manufacturing, during formulation and loading of smoke grenades, or upon detonation of grenades during training and testing operations. Colored smoke grenades are formulated and loaded at the Pine Bluff Arsenal, Arkansas. The primary aquatic systems receiving wastewaters at the arsenal are the Arkansas River and associated drainages. Prior to the installation of a pollution abatement facility in 1979, contamination to this system from untreated pyrotechnic wastes was reported as significant. Sufficient data to determine the toxicity of Solvent Green 3 in freshwater aquatic organisms are lacking. The 96-hr TL 50 for Pimephales promelas is >100 mg/L, which would indicate that the dye is relatively nontoxic. Static acute tests with fish and invertebrates exposed to a Solvent Yellow 33/Solvent Green 3 mixture (30:70), provide limited and inconsistent information. Mortality was observed in only one (rainbow trout) of the eight species tested at solubility limits, 0.076 mg/L Solvent Yellow 33 and <0.002 mg/L Solvent Green 3. Because sufficient data are not available, EPA guidelines could not be used to calculate a Final Acute Value for the dye, and, consequently, a Criterion Maximum Concentration could not be determined. Due to the possible deposition of the dye in aquatic sediments, toxicity studies with burrowing mayflies are recommended. Solvent Green 3, at a concentration of 10 mg/L, causes a transient reduction in growth of the green alga Selenastrum capricornutum. No toxic effects were observed at 1 mg/L. The Solvent Yellow 33/Solvent Green 3 mixture significantly reduces algal growth at the estimated aqueous solubility limits, 0.198 mg/L Solvent Yellow 33 and <0.002 mg/L Solvent Green 3. (See also W89-03768) (Lantz-PTT)
W89-03767

WATER QUALITY CRITERIA FOR COLORED SMOKES: SOLVENT YELLOW 33,
Oak Ridge National Lab., TN.
K. A. Davidson, and P. S. Hovatter.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A189 374. Price codes: A06 in paper copy, A01 in microfiche. Report No. ORNL-6383, November 1987. Final Report. 107p, 2 fig, 14 tab, 74 ref, 2 append. Army Project 86PP6810.

Descriptors: *Dyes, *Smoke, *Water pollution effects, *Toxicity, Algae, Fish, Invertebrates, Standards, Industrial wastewater.

The available data on the environmental fate, aquatic toxicity, and mammalian toxicity of Solvent Yellow 33, a quinoline dye used in colored smoke grenades, were reviewed. Colored smoke grenades are formulated and loaded at the Pine Bluff Arsenal, Arkansas. During typical production of pyrotechnic items, approximately 1% to 2% of the smoke formulation is released into the aquatic environment. The results of static acute toxicity tests indicate that Solvent Yellow 33 is not lethal to fish and aquatic invertebrates at solubility limits ranging from 0.089 mg/L at 12 C to 0.18 mg/L at 22 C. Toxicity tests with the green alga Selenastrum capricornutum show that Solvent Yellow 33 significantly reduces algal growth (measured as cell density and biomass) at the solubility limit of 0.20 mg/L. However, additional tests with a series of concentrations above and below solubility should be performed to accurately determine the toxicity of Solvent Yellow 33 in freshwater aquatic organisms. Consequently, according to the EPA guidelines, data are currently unavailable to establish the Criterion Maximum Concentration and the Criterion Continuous Concentration for the protection of aquatic life and its uses. (See also W89-03767) (Lantz-PTT)
W89-03768

ANNUAL REPORT, 1985: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
National Acid Precipitation Assessment Program, Washington, DC.
For primary bibliographic entry see Field 5B.
W89-03775

FATE AND EFFECTS OF DISPERSED AND NON-DISPERSED OIL IN ARCTIC MUDFLATS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W89-03777

RELATIONSHIP BETWEEN PRECIPITATION QUALITY, SHALLOW GROUND-WATER GEOCHEMISTRY, AND DISSOLVED ALUMINUM IN EASTERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-03782

NONPARAMETRIC METHOD FOR ESTIMATING THE JOINT PROBABILITY DENSITY OF BOD AND DO,
North Carolina Univ. at Charlotte. Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-03821

SIMPLIFIED SENSITIVITY ANALYSIS APPLIED TO A NUTRIENT-BIOMASS MODEL,
Saint Martin's Coll., Lacey, WA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W89-03824

DYNAMICS OF A STABLE, LARGE VOLUME, LABORATORY ECOSYSTEM CONTAINING DAPHNIA AND PHYTOPLANKTON,
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 2H.
W89-03840

EFFECTS OF LOW CONCENTRATIONS OF HEAVY METALS ON PLANKTON COMMUNITY DYNAMICS IN A SMALL, SHALLOW, FERTILE LAKE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
P. H. Kerrison, D. Annoni, S. Zarini, O. Ravera, and B. Moss.
Journal of Plankton Research JPLRD9, Vol. 10, No. 4, p 779 - 812, July 1988. 19 fig, 5 tab, 59 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Plankton, *Lakes, *Water pollution effects, *Heavy metals, *Population dynamics, Ecosystems, Lake sediments, Italy, Toxicity, Seasonal variations, Aquatic populations, Cadmium, Copper, Mercury, Biomass, Algae.

Significant differences in phytoplankton abundance developed among identical, untreated enclosures, maintained in a fertile lake in northern Italy for 14 days. Differences in soluble reactive phosphorus concentration were significant after 7 days and developed more rapidly if the water columns were isolated from the sediment. Three replicate enclosures were used per treatment to investigate heavy metal toxicity. For plankton abundance and physico-chemical variables, the within-treatment coefficient of variation exceeded 50% if experiments were >3 weeks. Containment within enclosures affected the ecosystem differently in different seasons, but planktonic populations resembled those in the lake. Cadmium, copper and mercury additions of between 10 and 100 micrograms/l had little immediate effect upon phytoplankton biomass in summer. In winter, marked reductions occurred in the first two days of the experiment. Zooplankton was more sensitive than phytoplankton to the

heavy metals in summer. As the direct toxicity of the heavy metals subsided, there was disruption of zooplankton predation and nutrient regeneration. In summer, reduced grazing by heavy-metal-sensitive zooplankton caused algae to proliferate, whereas in winter, inorganic nutrients later supported larger populations of algae than would otherwise have occurred. Low nutrient concentrations in summer probably reflected rapid uptake in productive conditions. Mercury persisted in the water for a shorter period than did either cadmium or copper. Copper remained longest in the water column and was largely associated with suspended particulate material. Cadmium also persisted in the water column but remained largely in solution. Heavy metal accumulation in sediment was not evident, but may have been masked by high background concentrations. (Author's abstract)
W89-03841

ECOLOGY OF A FREE-FLOWING RIVER OF THE SOUTHERN ALPS: THE BUCH (FRANCE): II. ACTION OF A POLLUTING FLUX ON THE WATER'S HYDROCHEMISTRY (ECOLOGIE D'UNE RIVIERE NON AMENAGEE DES ALPES DU SUD: LE BUECH (FRANCE): II. ACTION D'UN FLUX POLLUTANT SUR L'HYDROCHIMIE DU COURS D'EAU),
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
F. Vespini, P. Legier, and A. Champeau.
Annales de Limnologie ANLIB3, Vol. 24, No. 1, p 3-13, 1988. 5 fig, 3 tab, 5 ref. English summary.

Descriptors: *Water quality, *Stream pollution, *Water pollution effects, *Municipal wastewater, Wastewater disposal, Chemical properties, Path of pollutants, Acidity, Nitrates, Dissolved oxygen.

In its middle section, the Buech river drains wastewater from the city of Laragne. The spatial development of the wastewater's chemical nature was studied at six points on the sewer drainage system and the Veragne River, which receives wastewater outflow from the city and its slaughterhouse. Temporal evolution was noted for each hour of the day. The impact of waste on the Buech river was analyzed through samples taken at five points upstream and downstream from the confluence of the Buech and Veragne rivers. Though high in its tributary, pollution is rather low in the river itself. The study makes clear the overwhelming importance of dilution and sedimentation on biodegradation, which is barely detectable during the summer dry season. (Author's abstract)
W89-03842

INFLUENCE OF THE WATER POLLUTION ON THE STRUCTURE AND DYNAMICS OF BENTHOS IN THE STREAM VYDRICA (SMALL CARPATHIANS),
Komenskeho Univ., Bratislava (Czechoslovakia). Zoological Inst.
I. Krno, and D. Hullova.
Biologia (Bratislava) BLOAAO, Vol. 43, No. 6, p 513-526, 1988. 10 fig, 2 tab, 16 ref.

Descriptors: *Benthic fauna, *Benthos, *Water pollution effects, *Stream pollution, *Stream biota, Seasonal variation, Eutrophication, Czechoslovakia.

In a stream with low elementary flow (Vydrica, Small Carpathians), the proportion of periphyton, coarse and fine detritus and the functional feeding groups of macrozoobenthos does not fully correspond to the course of the river continuum. In lightly polluted parts of the stream, there was a close relationship between seasonal dynamics of periphyton, coarse detritus and the trophic feeding groups of macrozoobenthos. Slight eutrophication increased all quantitative parameters in all functional groups of macrozoobenthos, while strong eutrophication and toxicity caused a distinct decrease of shredders and scrapers, the losses of which were not compensated by an increase of collectors and predators. The proportion of the macrozoobenthos biomass in the oligosaprobic part represented 1.88% of the total organic material deposited on the bottom of the stream and the production reached 71 g/sq m; in worse oligosaprobity it was 2.52% or 99 g/sq m and in polysaprobity only 0.58% or 42 g/sq m. (Author's abstract)
W89-03847

REACTION OF BLACKFLY LARVAE (DIPTERA, SIMULIIDAE) TO PAPER-MILL WASTE WATERS,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
D. Illesova.
Biologia (Bratislava) BLOAAO, Vol. 43, No. 6, p 535-541, 1988. 1 fig, 1 tab, 8 ref.

Descriptors: *Aquatic insects, *Blackflies, *Larvae, *Pulp and paper industry, *Toxicity, *Insect behavior, *Industrial wastewater, *Water pollution effects, Stream pollution, Cellulose.

Reaction of black-fly larvae (Diptera, Simuliidae) to papermill waste waters was studied in a stream in Velka Fatra Mountains in Central Slovakia. Sensitivity of rheophilous and cold-stenothermic developmental stages of aquatic insects was tested in the laboratory. Exposure for 24 and 36 h did not cause mortality of black-fly larvae, but larvae attempted to migrate and ceased filter-feeding. After cellulose fibers, contained in the wastewaters, had sedimented, the migration tendency of larvae diminished and they resumed filter-feeding. These facts indicate that the diluted chemicals present in wastewater exerted no toxic effect on the black-fly larvae, but that their occurrence was affected by the solid fraction (cellulose fibers). (Author's abstract)
W89-03848

LAKE OKARO ECOSYSTEM: 1. BACKGROUND LIMNOLOGY,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
D. J. Forsyth, S. J. Dryden, M. R. James, and W. F. Vincent.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 1, p 17-28, 1988. 3 fig, 6 tab, 30 ref.

Descriptors: *Water pollution effects, *Limnology, *Lakes, *Ecosystems, *Eutrophic lakes, *Eutrophication, *New Zealand, Cyanophyta, Midges, Zooplankton, Anabaena, Lake Okaro.

Lake Okaro is a eutrophic lake on the central volcanic plateau of North Island, New Zealand. Its hypolimnion had become progressively depleted of dissolved oxygen between 1955 and 1964. Since then hypolimnetic anoxia has occurred annually. Secchi disc transparency changed little since 1955. Higher values in 1977/78 and 1983/84 appeared to be caused by greater proportions of the cladoceran Ceriodaphnia dubia in the zooplankton. Despite large interannual changes in the biological and chemical properties of Lake Okaro, its trophic state has changed since 1955. The phytoplankton species composition changed from no cyanobacteria in 1955/56 to persistent cyanobacterial blooms in 1963 and abundant and extensive blooms of Anabaena spiroides and A. flos-aquae in 1979/80. Elodea canadensis dominated the macrophyte assemblage and its abundance has changed little since 1963. Zooplankton numbers decreased between 1979/80 and 1985/86 because of a decline in the calanoid copepod population. The zooplankton assemblage, dominated by rotifers in 1979/80, was crustacean-dominated in 1982/83. Eutrophication coincided with a higher proportion of chironomids, particularly the littoral Polypedilum pavidus, which became abundant in the presence of cyanobacterial blooms. (Author's abstract)
W89-03859

CHANGES IN THE SUBMERGED MACROPHYTE VEGETATION OF LAKE ROTOITI, CENTRAL NORTH ISLAND, NEW ZEALAND,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
B. T. Coffey, and J. S. Clayton.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 215-223, 1988. 6 fig, 2 tab, 16 ref, 2 append.

Descriptors: *Water pollution effects, *Macrophytes, *Submerged plants, *Aquatic plants, *Aquatic weeds, *Lakes, *New Zealand, *Eutrophication, Vegetation, Limnology, Plant populations.

Lagarosiphon major dominated the submerged vegetation of Lake Rotoiti, New Zealand, between 1969 and 1985, but together with Elodea canadensis Myriophyllum propinquum, Potamogeton cheesmanii, and P. crispus, progressively declined in abundance score. The decline of Lagarosiphon was partly compensated for by the invasion and spread of Ceratophyllum demersum, which had the second highest abundance score by 1981. Potamogeton ochreatus, Myriophyllum triphyllum, and the charophytes Nitella hookeri and Chara coralina, maintained their abundance score throughout. The decline of Lagarosiphon was probably related to decreased water transparency resulting from accelerated eutrophication during this study period. (Author's abstract)
W89-03866

ASIATIC CLAM, CORBICULA FLUMINEA: AN INDICATOR OF TRACE METAL POLLUTION IN THE SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Dept. of Environmental Marine Chemistry.
For primary bibliographic entry see Field 5A.
W89-03872

EXCESS NITROGEN DEPOSITION: ISSUES FOR CONSIDERATION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
R. A. Skeffington, and E. J. Wilson.
Environmental Pollution ENPOEK, Vol. 54, No. 3/4, p 159-184, 1988. 3 fig, 94 ref.

Descriptors: *Nitrogen, *Nitrates, *Ecological effects, *Literature review, *Acid rain effects, *Air pollution effects, Ecosystems, Forests, Deposition, Nitrogen cycle, Path of pollutants, Reviews.

Some major mechanisms are reviewed by which deposition of inorganic N compounds from the atmosphere could be damaging forest and natural ecosystems. Twelve issues which needed further discussion or research were identified. These were: has N deposition increased; what is a N-saturated ecosystem; can the time of onset of N saturation be predicted; can fertilizer experiments simulate the effects of atmospheric deposition; are there relationships between N input and N leaching; is N deposition leading to acidification; does high N input lead to toxicity symptoms in trees; does N input increase tree susceptibility to stress; does N input induce nutrient deficiency; does increasing N affect natural plant communities; can a 'critical load' for protection of ecosystems be defined, and defining of the effects on aquatic ecosystems. There is a brief critical discussion of each issue. It is concluded that there is not enough understanding of ecosystem function to define a critical load objectively, but that limits can be defined for some ecosystems. (Author's abstract)
W89-03873

RESPONSE TO HEAVY NITROGEN APPLICATIONS IN FERTILIZER EXPERIMENTS IN BRITISH FORESTS,
Aberdeen Univ. (Scotland). Dept. of Forestry.
H. G. Miller, and J. D. Miller.
Environmental Pollution ENPOEK, Vol. 54, No. 3/4, p 219-231, 1988. 6 fig, 1 tab, 43 ref.

Descriptors: *Acid rain effects, *Nitrogen, *Nitrates, *Ecological effects, *Rainfall, *Air pollution effects, *Forests, Nitrogen cycle, Path of pollutants, Fertilization.

Increasing concern over the level of nitrogen inputs to forests in polluted rain has led to a number of suggestions of possible adverse conse-

quences under the general heading of nitrogen saturation. A saturated ecosystem may be one (a) in which the trees show no growth response to the addition of further nitrogen, (b) in which addition of further nitrogen leads to growth disturbances or reduction, or (c) in which elevated nitrogen inputs lead to increased losses of nitrate in streamwater. Experience gained from forest fertilizer experiments is used to examine each of these suggestions. A definition involving a lack of growth response (a) is shown to be based on a lack of understanding of the continuing changing patterns of nitrogen demand and mineralization in even-aged forests. Similarly, using growth disturbances (b) is unsatisfactory because, it is suggested, these are either secondary deficiencies that appear once growth accelerates with added nitrogen or are a consequence of changing growth with increasing size. A definition based on increased loss of nitrate is, by analogy with the situation for sulfate, at least superficially attractive. However, the fact that nitrate retention is predominantly biological, rather than chemical, makes for difficulties and the limited evidence available suggests that many exceptions and variations may exist. Whilst experience with forest fertilizers might not be entirely apposite, for example foliar uptake from polluted rain may be a factor, it is urged that at least any hypothesis put forward should be compatible with information gained from fertilizer trials. (Author's abstract)
W89-03874

ECOSYSTEM EFFECTS OF ATMOSPHERIC DEPOSITION OF NITROGEN IN THE NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
N. van Breemen, and H. F. G. van Dijk.
Environmental Pollution ENPOEK, Vol. 54, No. 3/4, p 249-274, 1988. 3 fig, 6 tab, 89 ref.

Descriptors: *Acid rain effects, *Ecological effects, *Air pollution effects, *Nitrogen, *Eutrophication, *Ammonium, Acidic soils, Nitrates, Forests, Nitrogen cycle, The Netherlands, Aluminum.

Atmospheric deposition of inorganic N, mainly ammonium volatilized from manure produced in intensive stockbreeding, on sensitive terrestrial and aquatic ecosystems in The Netherlands is in the order of 40 to 80 kg/ha/year. Proven effects of this deposition are (i) eutrophication with N, leading to floristic changes, (ii) acidification of base-poor sandy soils and of moorland pools, leading to higher concentrations of dissolved, potentially toxic metals such as Al(3+), and (iii) increased levels of nitrate in groundwater below woodlands. In acid forest soils, but not in soils under heathland, nitrification and leaching of nitrate is common. However, in very poor sandy forest soils and at very high ammonium inputs, nitrification may be too slow to prevent the development of high concentrations of ammonium. Both excessive acidification and excessive levels of ammonium probably play an important role in the general forest decline, which is most severe in the southern and central parts of the country, where ammonium inputs are highest. (Author's abstract)
W89-03875

EFFECT OF ATMOSPHERIC N DEPOSITION ON SURFACE WATER CHEMISTRY AND THE IMPLICATIONS FOR FISHERIES,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. J. A. Brown.
Environmental Pollution ENPOEK, Vol. 54, No. 3/4, p 275-284, 1988. 7 fig, 22 ref.

Descriptors: *Acid rain effects, *Water pollution sources, *Air pollution effects, *Nitrogen, *Surface water, *Fisheries, Chemical reactions, Nitrates, Deposition, Oligotrophic lakes.

In this paper the relative importance of NO3(-) and SO4(--) as anions in oligotrophic surface waters and evidence that NO3 concentrations have been increasing in recent decades is reviewed. The relationship between NO3(-) and the concentrations of cations (H(+) and Al(3+)) known to be harmful to aquatic biota is also discussed. It is generally concluded that although direct proof of an association is lacking, circumstantial evidence suggests that atmospheric input of nitrogen to soils on certain 'sensitive' geologies may be having consequences for surface waters and the biota living in them, especially at certain times of the year, e.g. snowmelt. In order to make chemical conditions suitable for fish survival, emission control policies may need to be adjusted to take account of nitrate effects alongside those of sulfate. (Author's abstract)
W89-03876

SURVIVAL OF JUVENILE RING-NECKED DUCKS ON WETLANDS OF DIFFERENT PH,
Patuxent Wildlife Research Center, Orono, ME. Maine Field Station.
D. G. McCauley, and J. R. Longcore.
Journal of Wildlife Management JWMAA9, Vol. 52, No. 2, p 169-176, April 1988. 4 tab, 52 ref.

Descriptors: *Ducks, *Juvenile growth stage, *Acidic water, *Wetlands, *Water pollution effects, *Acid rain, *Survival, Reproduction, Mortality, Hydrogen ion concentration, Alkalinity, Maine.

Brood and duckling survival of ring-necked ducks (Aythya collaris) was examined in relation to wetland water chemistry in east central Maine during 1983-85. Daily survival rates (DSR) of broods and ducklings were determined for 381 ducklings from 64 broods by counts of each brood at 6-10-day intervals during brood rearing. Twelve of 64 females lost entire broods. Only 176/381 ducklings survived to fledge. Brood survival for the 45-day rearing period was 0.7731; duckling survival was 0.3707. Young ducklings (< or = 24 days) survived at a lower rate (0.9750/day) than older (> or = 25 days) ducklings (0.9818/day)(P = 0.002). Survival rates of broods and ducklings did not differ among wetlands of high and low alkalinities. Brood survival did not differ among wetlands of different pH, but DSR of ducklings was lower (0.9763/day) on low-pH (<6.0) wetlands than on high-pH (< or = 6.1) wetlands (0.9816/day)(P= 0.049). Class IIb-III (25-45 days old) ducklings from the lowest-pH wetlands (<5.5) had the lowest DSR (0.9752), whereas Class IIb-III ducklings from the highest-pH wetlands (>6.5) had the highest DSR (0.9856)(P=0.009). (See also W89-03896) (Author's abstract)
W89-03895

FOODS OF JUVENILE RING-NECKED DUCKS: RELATIONSHIP TO WETLAND PH,
Patuxent Wildlife Research Center, Orono, ME. Maine Field Station.
D. G. McCauley, and J. R. Longcore.
Journal of Wildlife Management JWMAA9, Vol. 52, No. 2, p 177-185, April 1988. 3 tab, 52 ref.

Descriptors: *Ducks, *Hydrogen ion concentration, *Acidic water, *Wetlands, *Water pollution effects, *Acid rain, *Juvenile growth stage, *Food habits, Food chains, Invertebrates, Mortality, Survival, Sponges, Diets, Pondweeds, Maine.

Foods of 37 juvenile ring-necked ducks (Aythya collaris) from 16 different wetlands in east central Maine were examined in 1983-85. Invertebrates made up 70% aggregate dry weight (100% occurrence) of the foods of Class Ia-IIa (< or = 24 days old) ducklings and 32% (86% occurrence) of Class IIb-III (> or = 25 days old) ducklings. These percentages may be as high as 85% for Ia-IIa ducklings and 47% for IIb-III ducklings after adjusting for insect sclerites. Ducklings are invertebrates from 44 taxa and seeds or fibers from 23 plant taxa. Freshwater sponges (Porifera) were the most important invertebrate and constituted 23% of the foods of all ducklings. Seeds of pondweeds (Potamogeton spp.) were the most important plant foods. Diets of ducklings from high-pH (> or = 6.1) wetlands were more diverse (t = 2.54, P = 0.021) than those of low-pH (< 6.1) wetlands and consisted of 33 invertebrate taxa. Only 17 taxa occurred in ducklings from low-pH ponds. Class Ia-IIa ducklings from high-pH wetlands ate more invertebrates (77%) than ducklings from lower-pH wetlands (61%), although the difference was not significant. Sponges made up the largest percentage of the diets and occurred in similar amounts in high-pH (34%) and low-pH (31.5%) pH wetlands. (See also W89-0)(Author's abstract)
W89-03896

CLAY-MINERAL CONTRIBUTION TO THE WEATHERING MECHANISMS IN TWO CONTRASTING WATERSHEDS,
Geological Survey, Reston, VA.
C. G. Olson.
Journal of Soil Science JSSCAH, Vol. 39, No. 3, p 457-467, September 1988. 9 fig, 12 ref.

Descriptors: *Acid rain, *Clay minerals, *Acidic water, *Weathering, *Water pollution effects, Drainage patterns, Vermiculite, Watersheds, Path of pollutants, Bedrock, Catchment areas, Aluminum, Chemical properties, Illite, Soil types, Neutralization.

Two mountain watersheds in eastern USA showed sensitivity of their bedrock type to acidification from changes in atmospheric input: they were a Catoctin Mountain watershed on Precambrian metabasalt, and a Massanutten Mountain watershed developed on Silurian metaquartzites and shales. The role of clay minerals to neutralize potential increases in acid deposition was examined. Landscape position and drainage characteristics influence the clay mineral suites present at Catoctin, and an expandable clay component enables this watershed to adequately buffer the hydrochemical systems. A 14 angstrom hydroxy-interlayer vermiculite provided a sink for Al(3+), and also a possible neutralizing effect in the second watershed which was highly sensitive to acid deposition. (Author's abstract)
W89-03917

DREDGED MATERIALS - PROBLEMS ASSOCIATED WITH THEIR USE ON LAND,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W89-03918

FARMERS, FERTILISERS AND THE NITRATE FLOOD,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 5B.
W89-03935

CYPERMETHRIN TOXICITY: EFFECT ON THE CARBOHYDRATE METABOLISM OF THE INDIAN CATFISH, HETEROPNEUSTES FOSSILIS,
Gorakhpur Univ. (India). Dept. of Zoology.
B. A. Ansari, and K. Kumar.
Science of the Total Environment STENDL, Vol. 72, p 161-166, June 15, 1988. 2 tab, 24 ref.

Descriptors: *Toxicity, *Catfish, *Carbohydrates, *Biocides, *Pesticides, *Cypermethrin, *Fish, Pyrethroids, Water pollution effects, Metabolism, Heteropneustes fossilis, Glucose.

Adult H. fossilis of both sexes were collected locally and acclimatized at room temperature with a 12-h photophase for one week in dechlorinated tap water in 100-L glass aquaria. Toxicity tests revealed that the Indian catfish, is highly sensitive to cypermethrin, a synthetic pyrethroid. The LC50 value decreased with increasing exposure time, revealing a time-dependent action of cypermethrin. Following cypermethrin exposure, the fish swam erratically. Their gill movements increased, accompanied by loss of equilibrium. Most fish showed signs of hyperexcitation with extended pectoral and pelvic fins. There was an abrupt decline in both muscle and liver glycogen following cypermethrin exposure. The blood lactate, glucose and pyruvate levels were simultaneously elevated. It was concluded that cypermethrin affects the crucial pathways of carbohydrate metabolism

by directly or indirectly affecting certain regulatory substances and/or hormones. It is evident that the homeostatic mechanism existing between glucose, glycogen, lactic acid and pyruvic acid is seriously impaired to such an extent that it becomes critical for the survival of the fish. Therefore, the study of carbohydrate metabolism appears to be a promising field for the evaluation of toxicity of the synthetic pyrethroids. Biochemical studies confirmed this, showing that the effects on carbohydrate metabolites also revealed a time-dependent response. (Stoehr-PTT)
W89-03944

HEXAVALENT CHROMIUM: TOXICITY AND ITS IMPACT ON CERTAIN ASPECTS OF CARBOHYDRATE METABOLISM OF THE FRESHWATER TELEOST, COLISA FASCIATUS,
Gorakhpur Univ. (India). Dept. of Zoology.
K. Nath, and N. Kumar.
Science of the Total Environment STENDL, Vol. 72, p 175-181, June 15, 1988. 2 tab, 53 ref.

Descriptors: *Toxicity, *Chromium, *Carbohydrates, *Metabolism, *Fish, *Water pollution effects, Bioassay, Glucose, Heavy metals, Colisa fasciatus, Chemical analysis, Pollutants.

The effect of hexavalent chromium on the static bioassay was examined. The LC0, LC50, and LC100 values at 24, 48, 72, and 96 hours were determined. At 96 hours, the LC50 value was found to be 60 mg per liter. The impact of a sublethal concentration of 48 ppm on the liver glycogen and blood glucose levels was investigated during 3-96 hours. Liver glycogen exhibited significant depletion with all exposure periods except 3 hours. Blood glucose level increased significantly from 6 hours onwards, attaining its peak value at 72 hours. Exposure of fish to hexavalent chromium led to pronounced changes in the carbohydrate metabolism of the fish. The measurement of carbohydrate metabolites may provide a rapid, sensitive, simple, and apparently reproducible method for assessing the toxicity of heavy metals or other pollutants to fish. (Stoehr-PTT)
W89-03946

ENVIRONMENTAL FATE AND ECOLOGICAL IMPACT OF ORGANOSILICON MATERIALS: A REVIEW,
Dow Corning Corp., Midlands, MI. Health and Environmental Sciences Dept.
C. L. Frye.
Science of the Total Environment STENDL, Vol. 73, No. 1-2, p 17-22, July 1, 1988. 2 tab, 10 ref.

Descriptors: *Environmental effects, *Ecological effects, *Reviews, *Fate of pollutants, *Silicones, Organosilicon, Physical properties, Methylmercury, Methylsiloxanes, Model studies, Toxicity.

The potential threats posed by organosilicon materials are reviewed. In order to assess these threats reliably and safely, one must consider a material's physical properties such as vapor pressure, density, water solubility, lipid solubility, and often the molecular weight. These factors define how and where the substance is likely to be distributed in the environment, and if ecological consequences will occur. Biological models have been used to assess the effects of methylsiloxanes upon all forms of aquatic life. Environmental fate studies have also been used to assess these effects. Based on extensive toxicological and environmental studies, commercially important organosilicon materials do not appear to present any ecologically significant threat. Recurrent suggestions that methylsiloxanes might produce methylmercury species under aquatic conditions are also discussed and shown to be highly improbable. (Stoehr-PTT)
W89-03951

POSSIBLE METHYLATION OF INORGANIC MERCURY BY SILICONES IN THE ENVIRONMENT,
Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
For primary bibliographic entry see Field 5B.
W89-03952

COMPARISON OF THE RATES OF METHYLATION OF MERCURY(II) SPECIES IN AQUATIC MEDIA BY VARIOUS ORGANOTIN AND ORGANOSILICON MOIETIES,
Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
For primary bibliographic entry see Field 5B.
W89-03953

ORGANOLEADS IN THE ENVIRONMENT: A REVIEW,
Aston Univ., Birmingham (England). Dept. of Molecular Sciences.
For primary bibliographic entry see Field 5B.
W89-03955

EFFECTS OF CHEMICAL POLLUTION ON THE ACTIVITIES OF HEPATIC XENOBIOTIC METABOLIZING ENZYMES IN FISH FROM THE RIVER RHONE,
Ecole Nationale Veterinaire de Lyon (France). Lab. d'Ecotoxicologie.
G. Monod, A. Devaux, and J. L. Riviere.
Science of the Total Environment STENDL, Vol. 73, No. 3, p 189-201, July 15, 1988. 3 fig, 4 tab, 45 ref.

Descriptors: *Water pollution effects, *Fish, *Polychlorinated biphenyls, *Enzymes, Water quality, Pollutants, France, Biochemistry, Roach, Nase, Grayling, Natural water, Rivers, Metabolism.

Polychlorobiphenyl (PCBs) levels and hepatic xenobiotic metabolizing enzyme activities were measured in fish from three locations of the River Rhone to study the consequences of a constant loading of PCBs from a PCB incineration plant. Our results show that levels of PCBs and enzyme activities were higher in fish living downstream from the plant than in fish from two locations upstream, suggesting enzyme induction by PCBs. Enzyme activities were studied in spring and autumn in three species: nase (Chondrostoma nasus), roach (Rutilus rutilus) and grayling (Thymallus thymallus). Induction was observed for three cytochrome P-450-dependent monooxygenase activities (MO), i.e. 7-ethoxyresorufin O-deethylase (EROD), aryl hydrocarbon hydroxylase (AHH) and 7-ethoxycoumarin O-deethylase (ECOD). There was a close corrlation between EROD and AHH activities for all species. Glutathione S-transferase activities were also shown to be related to the PCB-levels. Conversely, cytochrome P-450 content and benzphetamine N-demethylase activity were not PCB level dependent. This study clearly demonstrates a close relationship between PCB contamination and MO activities in fish from the field and thus clearly emphasizes the interest in MO as a monitoring tool for estimating water quality. (Author's abstract)
W89-03958

IMPACT OF BLEACHED KRAFT MILL EFFLUENTS ON DRINKING WATER QUALITY,
Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research.
B. Wigilius, H. Boren, A. Grimvall, G. E. Carlberg, and I. Hagen.
Science of the Total Environment STENDL, Vol. 74, p 75-96, August 1, 1988. 9 fig, 4 tab, 41 ref.

Descriptors: *Chlorination, *Water pollution effects, *Pulp wastes, Chlorine, Effluents, *Water quality, *Drinking water, Kraft mills, Bleaching wastes, Organic compounds, Pollutants, Environmental effects, Pulp and paper industries, Toxicity, Mutagenicity, Public health, Water pollution sources.

A combined field and laboratory study aimed at comparing the evidence of health risks from pulp mill contaminants in drinking water is presented, with corresponding evidence from normal, chlorine disinfection by-products. The study was performed in a Swedish river basin with a large, public water works located downstream from a bleached kraft mill. Chemical analyses and bioassays for mutagenic activity were performed on samples of river water, drinking water and laboratory produced drinking water. The study showed that the bleached kraft effluents caused a considerable long-range transport of chloro-organic chlorine in drinking water produced downstream from the mill. As regards Ames mutagenic compounds, however, chlorination of naturally humic substances during the chlorine disinfection step in drinking water production, proved to be a far more important source. The contribution of volatile chloro-organic compounds from the kraft mill was also much smaller than the contribution from normal disinfection by-products. The chromosome aberration tests gave no clear evidence of a positive response for any of the samples tested. (Author's abstract)
W89-03959

IN VITRO MUTAGENICITY OF WATER CONTAMINANTS IN COMPLEX MIXTURES,
Howard Univ., Washington, DC. Dept. of Civil Engineering.
M. M. Varma, F. R. Ampy, K. Verma, and W. W. Talbot.
Journal of Applied Toxicology JJATDK, Vol. 8, No. 4, p 243-248, August 1988. 8 fig, 14 ref. NIH Grant 2-SO6-RR-08016.

Descriptors: *Toxicity, *Water pollution effects, *Chlorinated hydrocarbons, Hydrocarbons, Chlorination, Wastewater treatment, Assay, Bioassay, Bacteria, Salmonella.

Trihalomethanes, carbon tetrachloride, and trichloroethylene were tested in single, binary, and multi-complex mixtures using standard tester strains TA1535, TA1537, TA98, and TA100 of Salmonella typhimurium with and without addition of an in vitro metabolizing fraction S-9. Chloroform (CHCl3) was found to be mutagenic in all strains without S-9 activation. However, when tested with bromoform (15%), which was nonmutagenic singly, the combined effect of the mixture was nonmutagenic. CCl4 was a direct mutagen (without S-9) in all strains except TA1535. When combined with 85% CHCl3, only strains TA1535 and TA1537 were mutagenic. When tested with mammalian activation (S-9), CCl4 was mutagenic in all strains. However, when tested with CHCl3 (CHCl3 and CCl4-85:15), the mutagenic capability was lost. With or without S-9 Activation, multicomplex mixture of CHCl3, CCl4, and TCE (85:8:7) was mutagenic for a narrow range of doses in all strains. (Author's abstract)
W89-03991

FIELD EVALUATION OF AN ACID RAIN-DROUGHT STRESS INTERACTION,
Illinois Univ., Urbana.
W. L. Banwart.
Environmental Pollution (Series A) EPEBD7, Vol. 53, No. 1-4, p 123-133, 1988. 3 fig, 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Acid rain, *Drought, *Crop yield, *Stress, Environmental effects, Air pollution effects, Hydrogen ion concentration, Corn, Soybeans.

Moveable rain exclusion shelters (10.4 m x 40.9 m) were used to study the results of the interaction of acid rain and drought stress on corn and soybean yields. Soybeans and corn were treated with average rainfall amounts, and with one-half and one-quarter of these rainfall amounts (drought stress) at two levels of rainfall acidity, pH 5.6 and 3.0. While drought stress resulted in considerable yield reduction for Amsoy and Williams soybeans, no additional reduction in yield was observed with rainfall of pH 3.0, as compared to rainfall of approximately pH 5.6. Similar results were observed for one corn cultivar, Pioneer 3377. For one year of the study, however, yield of B73 x Mo17 (corn) was reduced 3139 kg/ha by the most severe drought, and an additional 1883 kg/ha by acid rain of pH 3.0, as compared to the control (pH 5.6). Yield reduction from acidic rain was considerably less at full water rates, resulting in a significant pH by drought stress interaction. However, during the second year of the experiment, no pH effect or drought by pH interaction was observed for this cultivar. The

reason for the difference in the two years was not identified. (Author's abstract)
W89-04010

EFFECTS OF SIMULATED ACID RAIN ON SOIL SOLUTION COMPOSITION AND ORCHARDGRASS SEEDLING VIABILITY,
Tennessee Univ., Knoxville. Dept. of Plant and Soil Science.
G. W. Haun, J. Wolt, and J. H. Reynolds.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 1037- 1043, July/August 1988. 2 fig, 6 tab, 30 ref.

Descriptors: *Soil-water-plant relationships, *Soil solution, *Water pollution effects, *Acid rain, *Orchardgrass, *Environmental effects, *Soil chemistry, *Seedlings, *Simulated rainfall, Forages, Grasses, Hydrogen ion concentration, Rainfall, Growth, Conductivity, Chemical composition, Soil properties, Calcium, Magnesium, Potassium, Sodium, Aluminum, Ammonium, Chlorides, Nitrates, Sulfates, Heavy metals, Cations, Anions, Ions.

Viability of orchardgrass (Dactylis glomerata) seedlings was monitored concurrently with simulated acid rainfall applications (pH 4.3-2.5) on surface soils sampled from established sod which had been unfertilized in the prior two years. Simulated rainfall of pH 3.1 tended to result in increased seedling viability in comparison to other rainfall pH, but the effect of rainfall pH was significant in only six of 16 counting dates. Maximum seedling numbers and days to maximum were unaffected. Increased rainfall acidity (pH 4.3-3.1) increased total seedling dry weight. Soil solution pH decreased and electrical conductivity increased with increasing acidity of simulated rainfall. Generally, increasingly acid rainfall resulted in linear (sometimes quadratic) increases in cation and anion components of soil solution with the exception of Al, Na, and NH4. The rainfall pH x soil interaction was not significant for any solution component. Calcium ion activity was unaffected, while Al(3+) activity increased with increased rainfall acidity. The Ca/Al activity ratio decreased 64-fold with increasing acidity of simulated rainfall. No association between orchardgrass seedling response and soil solution composition was apparent. (Author's abstract)
W89-04018

POTENTIAL FOR BUFFERING OF ACIDIC PRECIPITATION BY MINERAL WEATHERING IN A FORESTED ENTISOL,
Wisconsin Univ., Madison. Dept. of Soil Science.
C. S. Li, J. G. Bockheim, J. E. Leide, and D. A. Wentz.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 1148- 1154, July/August 1988. 4 fig, 4 tab, 36 ref. Electric Power Research Institute RP-2174.2.

Descriptors: *Water pollution effects, *Hydrolysis, *Buffering, *Acid rain, *Weathering, *Minerals, *Forest soils, *Soil chemistry, Rainfall, Acidity, Chemical properties, Soil types, Soil science, Soil cores, Precipitation, Soil water, Groundwater, Hydrogen, Hydrogen ion concentration, Calcium, Magnesium, Sodium, Potassium, Silicon, Heavy metals, Mineralogy, Thermodynamics, Water quality, Leaching.

Bulk precipitation, soil water, and groundwater chemistry were monitored at Round Lake, a small, forested catchment in northwestern Wisconsin receiving acidic precipitation (pH 4.6). The groundwater basin retained H(+) and released nonhydrolyzable cations and Si. The percentages of plagioclase feldspar, hornblende, olivine, and augite increased with depth in soils from the catchment; quartz, orthoclase feldspar, and weathered mica decreased with depth. Thermodynamic stability indices indicate that the soil water and groundwater are undersaturated with respect to hornblende, chlorite, olivine, augite, plagioclase, and orthoclase feldspars and that these minerals may be undergoing dissolution. Minimally disturbed soil cores were leached with dilute H2SO4 and distilled water. When the pH of the extracting solution was 4.5 or higher, Ca was released in the greatest amounts, followed by Si, Mg, K, Na, and Al. This ranking is similar to that for cations in groundwater. Leaching with a pH 3.0 solution released Si in the greatest amounts from the C horizon, followed by the Bw2, Bw1, and A + B/E horizons. This trend parallels the depth distribution of weatherable minerals in the very fine sand fraction. Results from the laboratory leaching study confirm the chemical modeling studies, indicating that mineral weathering (hydrolysis) can contribute to buffering within the groundwater basin at Round Lake. (Author's abstract)
W89-04020

WATER QUALITY AND HYDROGEOLOGIC DATA FOR THREE PHOSPHATE INDUSTRY WASTE-DISPOSAL SITES IN CENTRAL FLORIDA, 1979-80,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. L. Miller, and J. Sutcliffe.
Available from Books and Open File Report Section, USGS Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 83-4256, 1984. 184p, 57 fig, 21 tab, 89 ref.

Descriptors: *Chemical wastes, *Water pollution sources, *Water quality data, *Mining wastes, *Phosphates, *Florida, Water levels, Lithologic logs, Hydrogeology, Precipitation, Industrial plants, Industrial wastes, Metals, Nitrogen compounds, Radiochemical analysis, Organic compounds, On-site data collection.

Geologic, hydrologic, and water quality data and information on test holes collected in the vicinity of gypsum stack complexes at two phosphate chemical plants and one phosphatic clayey waste disposal pond at a phosphate mine and beneficiation plant in central Florida are presented. The data were collected from September 1979 to October 1980 at the AMAX Phosphate, Inc. chemical plant, Piney Point; the USS Agri-Chemicals chemical plant, Bartow; and the International Minerals and Chemical Corporation Clear Springs mine, Bartow. Approximately 5,400 field and laboratory water quality determinations on water samples collected from about 100 test holes and 28 surface-water, 5 rainfall, and other sampling sites at phosphate industry beneficiation and chemical plant waste disposal operations are tabulated. Maps are included to show sampling sites. (USGS)
W89-04061

PROCESSES OCCURRING IN RESERVOIRS RECEIVING BIOGENIC AND POLLUTING SUBSTANCES,
Y. S. Vasilev, and N. N. Rolle.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 583-586, April 1988. 1 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 17-19, October 1987.

Descriptors: *Water pollution effects. *Reservoirs, *Eutrophication, Ecological effects, Heterotrophic bacteria, Algae, Mixing, Toxicity, Species composition, Inorganic compounds.

The accumulation of inorganic salts, readily-mineralized organic substances (primarily compounds of phosphorus and nitrogen), heavy metals, and other pollutants acts on abiotic and biotic factors in reservoirs; it also changes the ecological conditions, leads to eutrophication, causes disturbance of the oxygen regime and of the processes of the biotic cycle, and has a toxic effect on aquatic organisms. The entry of organic pollutants into a reservoir leads to an increase in heterotrophic bacteria that decompose these compounds to mineral salts with the consumption of dissolved oxygen. The mass development of unicellular and filamentous algae leads to an increase of turbidity, and their subsequent death and decomposition results in a considerable decrease of oxygen in the bottom layers, including the formation of anaerobic zones. As a consequence of lower current velocities and unfavorable water-mass mixing and gas-exchange conditions, a reservoir has a limited capacity for self-purification, unlike a river in its natural state. An increase in the concentration of biogenic elements not only leads to eutrophication of reservoirs but also has a direct toxic effect on aquatic organisms. Along with other indices characterizing the quality of their habitat, changes in the species composition of aquatic organisms can be used to monitor aquatic ecosystems, including reservoirs, for ecological disturbance. (Shidler-PTT)
W89-04221

EFFECT OF ALUMINIUM AND CALCIUM IONS ON SURVIVAL AND PHYSIOLOGY OF RAINBOW TROUT SALMO GAIRDNERI (RICHARDSON) EGGS AND LARVAE EXPOSED TO ACID STRESS,
Odense Univ. (Denmark). Biological Inst.
A. Thomsen, B. Korsgaard, and J. Joensen.
Aquatic Toxicology AQTODG, Vol. 12, No. 4, p 291-300, June 1988. 6 fig, 23 ref.

Descriptors: *Water pollution effects, *Aluminum, *Calcium, *Acid rain effects, *Trout, *Toxicity, Cations, Mortality, Survival, Fish physiology, Fish eggs, Hatching, Larval growth stage, Hydrogen ion concentration, Stress, Lethal limit, Respiration.

The most important ions in relation to fish mortality in acid water are calcium and aluminum. In fertilized non-hatched eggs from rainbow trout exposed to different low-pH levels mortality occurred at regular intervals during development. Hatching rate was delayed at the lowest ambient pH levels and hatching success was reduced accordingly. The lethal concentration of aluminum ions was 3.8 mg Al/l in soft water and 71 mg Al/L in hard water, when determined on day 25 after hatching at pH 7. In general, exposure to aluminum reduced survival. However, the greatest reduction in survival was observed in relation to the calcium-ion concentration of the ambient medium. The protecting effect of calcium against aluminum may partly be explained by the fact that polymerized Al forms are precipitated in a medium containing high concentrations of calcium ions (150 mg Ca/L). Exposure to Al reduced dry weight by 9% and respiration rate by 13% in soft water at pH 5. Aluminum ions had only minor effects on the body concentration of Ca and on the cardiac rate. Respiration rate was reduced by 41% by a lowering of pH only, and low pH also had the greatest reducing effect on cardiac rate (32% at pH 5 in soft water). Previous exposure to low pH, low calcium-ion and high aluminum-ion concentrations had no significant effect on larval growth after transfer to hard water at pH 7. (Author's abstract)
W89-04246

EFFECT OF CADMIUM ON THE REPRODUCTION STRATEGY OF DAPHNIA MAGNA,
Utrecht Rijksuniversiteit (Netherlands). Research Group for Aquatic Toxicology.
C. W. M. Bodar, C. J. Van Leeuwen, P. A. Voogt, and D. I. Zandee.
Aquatic Toxicology AQTODG, Vol. 12, No. 4, p 301-309, June 1988. 5 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Cadmium, *Spawning, *Daphnia, Reproduction, Eggs, Hatching, Juvenile growth stage, Lethal limit, Stress, Survival, Animal growth, Size, Biomass.

Survival, number of neonates per female, first day of reproduction, and neonate size were investigated in Daphnia magna exposed to cadmium concentrations ranging from 0 to 50.0 ppb. A 25-day LC50 of about 10.0 ppb was found. The onset of reproduction was delayed at concentrations of cadmium above 5.0 ppb, but was not affected at lower levels. Cadmium concentrations of 0.5, 1.0, and 5.0 ppb increased the average number of neonates per female significantly. The size of the neonates, however, decreased significantly with increasing cadmium concentrations, thereby probably offsetting their survival probability. The reproduction strategy of D. magna seems to be changed by low concentrations of cadmium. Compared with unstressed animals cadmium-stressed animals produce larger broods with smaller neonates, but at higher cadmium concentrations brood size and body size both decline. The major question is whether an animal under Cd stress specifically changes its

reproduction strategy, or whether the observed changes should be considered only as a nonspecific response, i.e., 'hormesis'. It has been suggested that hormesis results from a nonspecific effect on the growth-control mechanism. Indeed the increase of the reproduction biomass at 0.5 and 1.0 ppb Cd might be explained to a certain degree by this theory; the reason for increase in the number of maturing oocytes, however, remains unclear. (Author's abstract)
W89-04247

EFFECT OF SUBLETHAL CONCENTRATIONS OF COPPER ON THE CRITICAL THERMAL MAXIMA (CTMAX) OF THE FANTAIL (ETHEOSTOMA FLABELLARE) AND JOHNNY (E. NIGRUM) DARTERS,
Miami Univ., Oxford, OH. Dept. of Zoology.
M. J. Lydy, and T. E. Wissing.
Aquatic Toxicology AQTODG, Vol. 12, No. 4, p 311-321, June 1988. 3 fig, 1 tab, 39 ref.

Descriptors: *Water pollution effects, *Copper, *Thermal stress, *Fish, *Bioassay, Surface water, Water temperature, Streams, Fish populations, Lethal limit, Toxicity, Tolerance, Fish behavior, Temperature effects.

Copper concentrations of 1 to 15 microg/L have been reported for unpolluted U.S. surface waters. Summer water temperature in small streams can reach 30-35 C; hence, the possible interactions between copper toxicity and temperature need to be addressed to assure survival of fish populations in these systems. Static 96-h copper LC50 values for darters were used to determine ranges of copper concentrations for sublethal tests. LC50 values ranged from 330-392 microg/L for fantail darters and 483-602 microg/L for johnny darters. The critical thermal maximum (CTMax--temperature at which coordinated locomotor movements are lost in ectothermic vertebrates) is used to define the upper limit of temperature tolerance for a variety of organisms. The CTMax method was used to determine the upper temperature tolerance of both species after a 96-h sublethal copper exposure. Copper exposure (concentrations above no-effect levels) for as little as three days significantly decreased the CTMax values for each species. A gradual increase in CTMax values was observed when fantail and johnny darters were removed from dosing water and placed into control water. It is proposed that the CTMax method be considered for use in contaminant-hazard evaluation because of its sensitivity to fairly low levels of toxicant, its short duration in comparison to chronic tests, and because it detects problems when damage is at a reversible stage. (Shidler-PTT)
W89-04248

PATHOLOGICAL EFFECTS IN FRESHWATER FISH POECILIA RETICULATA (GUPPY) AND ORYZIAS LATIPES (MEDAKA) FOLLOWING METHYL BROMIDE AND SODIUM BROMIDE EXPOSURE,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Pathology.
P. W. Wester, J. H. Canton, and J. A. M. A. Dormans.
Aquatic Toxicology AQTODG, Vol. 12, No. 4, p 323-343, June 1988. 7 fig, 2 tab, 32 ref.

Descriptors: *Water pollution effects, *Fumigants, *Bromides, *Fish, *Methyl Bromide, Animal pathology, Electron microscopy, Histology, Animal tissues, Muscle, Gills, Guppies, Medakas, Immature growth stage, Fish behavior.

To study the effects of the fumigant methyl bromide and its inorganic residue, bromide, young guppies and medakas were exposed to these chemicals for 1 and 3 months. The concentration ranges were 10-32,000 mg/L (guppy) and 180-5600 mg/L (medaka) for sodium bromide and 0.032-3.2 mg/L for methyl bromide. A short-term study, in which scanning electron microscopy of the gills was included, was conducted with the two highest concentrations of methyl bromide for the evaluation of lethal effects. In the guppy, a sodium bromide concentration of 100 mg/L and higher caused paresis and paralysis. Histopathology of animals exposed to concentrations of 3200 mg/L showed muscle changes indicative of a functional neuromuscular disturbance. Medakas showed only activation of the thyroid epithelium at all concentrations tested, including the lowest (180 mg/L). In the methyl bromide study, no specific effects were observed in the long-term study of either species. In the short-term study, however, major degenerative and regenerative changes were found in the superficial epithelia, especially of the gills and oral mucosa. It is concluded that bromide is goitrogenic in both species at low concentrations and in guppies at higher concentrations it also affects skeletal muscle, blood vessels, and gonads. Methyl bromide has no specific action but is irritating for superficial epithelia at relatively high concentrations. (Author's abstract)
W89-04249

REGULATION OF BLOOD HAEMOGLOBIN AND ELECTROLYTES IN RAINBOW TROUT SALMO GAIRDNERI (RICHARDSON) EXPOSED TO NITRITE,
Dundee Univ. (Scotland).
E. M. Williams, and F. B. Eddy.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 13-27, September 1988. 6 fig, 2 tab, 44 ref. NERC grant Gr/3/5422.

Descriptors: *Water pollution effects, *Toxicity, *Nitrites, *Trout, *Blood, Hemoglobin, Electrolytes, Potassium, Sodium, Chlorides, Lethal limit, Tolerance, Survival.

A study was conducted to investigate the hematological consequences and anion homeostasis in rainbow trout after short-term and longer-term nitrite exposure. Trout (30-70 g) were exposed to environmental nitrite for periods varying from 2 to 24 h; after 12 h blood-plasma nitrite concentration was eight times the environmental levels (0.5 mmol/L). The rise was followed by an increase in methemoglobin levels from around 3% to > 60%. After 2-h nitrite exposure the concentrations of plasma potassium, sodium, and chloride fell, followed 2 h later by an increase in inter-erythrocyte potassium and sodium concentration with increased red-cell volume. Twelve-h nitrite exposure led to an increase in the red-cell population, the new cells being smaller and containing less hemoglobin. After 24-h exposure, fish fell into two groups: nitrite-intolerant fish with high levels of plasma nitrite and methemoglobin and nitrite-tolerant fish with low plasma nitrite levels. Thus, there is a wide spectrum of nitrite tolerance in trout; this may be of considerable consequence in populations where nitrite is a significant environmental factor. All fish surviving 24-h nitrite exposure had lower plasma potassium levels than unexposed fish. (See also W89-04251) (Author's abstract)
W89-04250

ANION TRANSPORT, CHLORIDE CELL NUMBER AND NITRITE-INDUCED METHAEMOGLOBINAEMIA IN RAINBOW TROUT (SALMO GAIRDNERI) AND CARP (CYPRINUS CARPIO),
Dundee Univ. (Scotland). Dept. of Biological Sciences.
E. M. Williams, and F. B. Eddy.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 29-42, September 1988. 5 fig, 1 tab, 43 ref. NERC grant Gr/3/5422.

Descriptors: *Water pollution effects, *Toxicity, *Nitrites, *Trout, *Carp, *Fertilizers, Ion transport, Gills, Blood, Salinity, Chlorides, Bicarbonates, Animal metabolism, Tolerance.

The level of nitrate in British rivers and freshwater supplies is increasing, particularly in areas where intensive use of nitrogenous fertilizers is common practice. Since this nitrate may be reduced to nitrite by bacterial action, the toxic effects of nitrite on ionic transport and hemoglobin function in fish were investigated. Under similar environmental conditions the maximal rates of chloride and nitrite uptake in carp (25 and 81 micromol/h/kg) were lower than in rainbow trout (368 and 198 micromol/h/kg). The rate at which anions are transported may be linked with the animals' adaptability to changes in salinity, the euryhaline trout being much more tolerant to seawater than the stenohaline carp, which is unable to survive in 40% seawater for more than three days, while trout can fully adapt to 100% seawater in a few days. In freshwater fish, chloride is exchanged across the gill epithelium for bicarbonate ions (or anion equivalents), and this exchange helps to regulate acid/base balance. Carp possess 47% fewer gill chloride cells than trout. In vitro, methemoglobin formation occurs more rapidly in carp blood, 5.58%/h compared with trout, 3.39%/h. The carp hemoglobin molecule is more sensitive to nitrite oxidation than trout hemoglobin and the rate of methemoglobin reduction is more rapid in carp red cells. However, carp are more tolerant to nitrite than are trout because of their lower rate of branchial uptake of nitrite. (See also W89-04250) (Shidler-PTT)
W89-04251

QUANTITATION OF CHEMICALLY INDUCED DAMAGE TO DNA OF AQUATIC ORGANISMS BY ALKALINE UNWINDING ASSAY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
L. R. Shugart.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 43-52, September 1988. 4 fig, 20 ref. Department of Energy contract DE-AC05-840R214000.

Descriptors: *Water pollution effects, *DNA, *Fish, *Benzo(a)pyrene, Quantitative analysis, Bluegills, Fathead minnows, Fluorometry, Liver, Hydrogen ion concentration, Temperature, Animal pathology.

The effect of chronic exposure to the genotoxic chemical benzo(a)pyrene (BaP) on the integrity of DNA (as measured by the level of DNA double-strandedness) was investigated in two aquatic organisms. In order to facilitate these studies, a method for the rapid and facile isolation of DNA from either the liver of bluegill sunfish or the entire fathead minnow was developed. DNA was examined for BaP-induced strand breaks using an alkaline unwinding assay where strand separation is achieved under defined conditions of pH and temperature, and the amounts of double-stranded and single-stranded DNA present were quantified by fluorescence measurements. It was observed that damage to liver DNA of the bluegill during chronic exposure to water containing BaP proceeds through two distinct phases. There was an initial phase in which the decline of DNA double-strandedness was immediate and rapid; by day 16 the level was 10% of that observed in nonexposed fish. During the next phase, which occurred subsequent to day 16, the level of double-strandedness increased and by day 30 was approximately that of the control population. Exposure of fathead minnows to BaP, under conditions identical to those for bluegills, resulted in similar DNA damage during the initial phase of exposure. (Author's abstract)
W89-04252

PHENOL AND SULFIDE INDUCED CHANGES IN THE OVARY AND LIVER OF SEXUALLY MATURING COMMON CARP, CYPRINUS CARPIO,
Kalyani Univ. (India). Dept. of Zoology.
V. Kumar, and D. Mukherjee.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 53-59, September 1988. 2 fig, 2 tab, 13 ref.

Descriptors: *Pollutant identification, *Water pollution effects, *Phenols, *Sulfides, *Carp, Animal tissues, *Industrial wastes, Cholesterol, Liver, Pulp wastes, Animal pathology, Fish physiology, Biochemistry, Ganges River.

A study was performed: (a) to determine the content of phenol and sulfide of the waste discharge of pulp and jute mills to the Ganges River; and (b) to investigate the effects of these two pollutants on the reproductive physiology and biochemistry of carp under laboratory conditions. Paper-mill and

jute-mill effluents were monitored for one year. Significant amounts of phenol and sulfide were present in pulp-mill effluent but not in jute-mill discharge. Sexually-maturing carp were exposed for 30 days to sublethal concentrations of phenol and sulfide, much below the concentrations observed in pulp-mill effluent, and the cholesterol levels in the ovary and liver were measured. Both contaminants caused a gradual and significant increase of hepatosomatic-index values and the cholesterol content of ovary and liver. Gonadosomatic-index (GSI) values, on the other hand, decreased gradually. Accumulation of ovarian cholesterol, coupled with lower GSI values in the treated fish, could result from reduced steroidogenesis. Increased hepatic-cholesterol levels suggest that hepatic malfunction in treated fish is responsible for impaired ovarian maturation. Comparative field studies should be carried out in the Ganges to determine if wild fish populations are similarly affected. (Author's abstract)
W89-04253

JOINT TOXICITY OF PESTICIDE TANK-MIXES TO RAINBOW TROUT,
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
P. Matthiessen, G. F. Whale, R. J. Rycroft, and D. A. Sheahan.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 61-75, September 1988. 1 fig, 8 tab, 12 ref.

Descriptors: *Water pollution effects, *Agricultural chemicals, *Pesticide toxicity, *Synergistic effects, *Trout, Aquatic animals, Juvenile growth stage, Herbicides, Fungicides, Spraying, Lethal limit, Insecticides.

Many agricultural pesticides are applied as so-called 'tank-mixes' in which approved formulations of herbicides, fungicides, and insecticides are mixed in the spray tank. The toxic action of two-component mixtures to aquatic fauna is often described by the concentration-addition model which assumes that additive joint effects occur when each component has a similar mode of toxic action, and that neither component influences the biological action of the other. The toxicity to trout (Salmo gairdneri) fingerlings of eleven tank-mixes composed of pairs of six fungicides and herbicides (prochloraz, fenpropimorph, diclofop-methyl, tridemorph, benzoylprop-ethyl and propiconazole) was measured using 96-h LC50 tests. The toxicity of the mixtures ranged from being half of that expected on the basis of additive toxicity of the components, to < 1.4 times the expected value. In view of the degree of experimental error inherent in the LC50 determinations, these data provide no evidence for the existence of synergistic (i.e., more-than-additive) toxicity of the respective tank-mixes. However, this preliminary work should be regarded with caution because the pesticide concentrations in the test solutions were not verified by analysis. Furthermore, in some cases, the mixture components had widely-differing toxicities, so that the less-toxic component may not have contributed significantly to the mixture toxicity. (Shidler-PTT)
W89-04254

ACUTE RESPONSE TO SODIUM HYPOCHLORITE IN RAINBOW TROUT ACCLIMATIZED TO PULP AND PAPER MILL EFFLUENTS,
Helsinki Univ. (Finland). Dept. of Zoology.
A. Soivio, E. Nikunen, and H. Tuurala.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 77-87, September 1988. 3 fig, 3 tab, 48 ref.

Descriptors: *Water pollution effects, *Toxicity, *Pulp wastes, *Trout, *Fish physiology, Animal pathology, Histology, Gills, Liver, Lethal limit, Bleaching wastes, Enzymes, Inhibition, Lakes, Risk assessment, Lake Vatia, Pulp and paper industry.

The environmental risk of hypochlorite spills from pulp and paper mills was estimated from acute toxicity tests and histological examinations. Rainbow trout (Salmo gairdneri) fingerlings were exposed to sodium hypochlorite (NaClO) in semistatic LC50 tests for 48 h in dechlorinated Helsinki tap water and water from Lake Vatia (21 km downstream from a kraft pulp mill). Fish were also exposed for 17 days to Lake Vatia water after which an acute exposure to sodium hypochlorite was made, for which physiological samples were analyzed. The 48-h LC50 of bleached kraft pulp mill effluent was 35%. The 17 days' caging period in the lake water caused disturbances in osmotic regulation, depletion of liver glycogen, and inhibition of liver UDP-glucuronosyltransferase. The gills of the exposed fish were microscopically examined. The epithelium of the secondary lamellae in the NaClO-exposed gills was thicker than in the controls (48-h LC50 0.35 mg Cl/L) and the lamellae were curled and had constricted blood spaces. The gill epithelium of fish exposed to NaClO in water from Lake Vatia was swollen and vacuolized (48-h LC50 0.09 mg Cl/L). The gills of fish exposed to 20% pulp-mill effluent as well as the gills of fish acclimatized for 17 days in Lake Vatia water were quite normal in structure. However, after hypochlorite exposure the gills of the pre-acclimatized fish were almost totally destroyed. (Author's abstract)
W89-04255

TEMPERATURE-INDUCED ALTERATIONS IN THE METABOLIC ACTIVATION OF BENZO(A)PYRENE TO DNA-BINDING METABOLITES IN THE BLUEGILL FRY CELL LINE BF-2,
Purdue Univ., Lafayette, IN. Dept. of Medicinal Chemistry and Pharmacognosy.
T. A. Smolarek, S. Morgan, and W. M. Baird.
Aquatic Toxicology AQTODG, Vol. 13, No. 1, p 89-97, September 1988. 2 fig, 1 tab, 13 refs. PHS grant CA-40228.

Descriptors: *Water pollution effects, *Benzo(a)pyrene, *Temperature effects, *Animal metabolism, *DNA, *Carcinogens, Bluegills, Juvenile growth stage, Tissue analysis, Aromatic compounds, Hydrocarbons, Cultures, Incubation.

Many carcinogenic chemicals such as the environmental pollutant benzo(a)pyrene (BaP) require metabolic activation to reactive DNA-binding intermediates in order to induce cancer. To determine whether temperature affects the amount and proportion of BaP metabolized to DNA-binding compounds, cultures of the bluegill fry cell line BF-2 maintained at 23 C and 35 C were exposed to BaP. Exposure at 35 C resulted in a 61% increase in the amount of BaP metabolized after 24 h compared with cultures incubated at 23 C. The amount of BaP bound to DNA in cultures exposed to BaP at 35 C was 97% greater at 24 h and 61% greater at 48 h than at 23 C. The increase in the major BaP-deoxyribonucleoside adduct, (+)-anti-BaP-7,8-diol-9,10-epoxide-deoxyguanosine, or (+)-anti-BaPDE-deoxyguanosine, at 35 C, was 314% at 24 h and 100% at 48 h. There was no significant change in the amount of syn-BaPDE-deoxyguanosine. These results indicate that although the amount of BaP metabolized by BF-2 cell cultures is 60% greater at 35 C than at 23 C, the amount of BaP bound to DNA through (+)-anti-BaPDE increased by more than 300%. Thus increased temperature can increase the proportion of BaP metabolized to an ultimate carcinogenic metabolite in BF-2 cells in culture. (Author's abstract)
W89-04256

RELATIONSHIP OF KASCHIN-BECK AND KESHAN DISEASES WITH HYDROGEOCHEMISTRY,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
F. Hongci.
Environmental Geology and Water Sciences 12(1):23-28, August 1988 EGWSEI. 4 fig, 8 ref.

Descriptors: *Water pollution effects, *Human diseases, *Public health, *Geochemistry, China, Kaschin-Beck disease, Keshan disease, Trace elements, Calcium, Geohydrology.

Kaschin-Beck Disease and Keshan disease (an endemic disease of the myocardium) are wide spread in China. The geographic distribution of Kaschin-Beck and Kesahan diseases shows that their genesis must be due to an environmental factor. Shortly after investigating the endemic area in Huanglong County, Shaanxi Province in 1971, it was determined that Kaschin-Beck and Kesshan diseases were caused by drinking groundwater from specific strata, thereby relating the known distribution sites of the endemic with the regional hydrogeology. Thus, hydrogeochemistry can be used to explain the distribution of the diseases. Regarding the hydrogeochemical features of Kaschin-Beck and Keshan diseases, two hydrogeological types can be differentiated: (1) related to acidic magmatic rocks; and (2) releated to oil-bearing formations. The pathogenic groundwater in these areas has its own water qualities which distinguish it from normal fresh water. According to the common chemical properties of the water in the two disease areas and based on some foreign environmental medical reports, it is concluded that the principle pathogenic factor is the richer trace element concentration and low hardness (or calcium) of the water. There are two ways to control the Kaschin-Beck and Keshan disease: one is to improve the water quality and the other is to change the water source. (Davis-PTT)
W89-04322

EFFECTS OF CHLORINE ON MICROBIAL COMMUNITIES IN NATURALLY DERIVED MICROCOSMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. R. Pratt, N. J. Bowers, B. R. Niederlehner, and J. Cairns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9 , p 679-687, September 1988. 2 fig, 8 tab, 24 ref.

Descriptors: *Water pollution effects, *Chlorine, *Microenvironment, *Microbiological studies, *Species, Microcosms, Mesocosms, Protozoa, Biomass, Bacteria, Fungi, Algae, Composition, Chlorophyll a.

Laboratory microcosms and field enclosures were used to evaluate effects of chlorine on microbial community structure and function. Microcosms were exposed to chlorine (as sodium hypochlorite) at concentrations up to 308 micrograms/L total residual chlorine (TRC) for 28 days. Test systems were sampled weekly to evaluate protozoan species accrual, biomass distribution, microbial enzyme activity, and macronutrient retention. Protozoan species numbers were depressed at all sampling times at TRC concentrations > or = 25 micrograms/L. Algal biomass (chlorophyll a) was adversely affected at 2 micrograms/L, and alkaline phosphatase activity was inhibited at > or = 6 micrograms/L. Other biomass measures and macronutrient retention were affected at 25 to 308 micrograms/L. Oxygen production was depressed at > or = 25 micrograms/L. Field enclosures (sediment-water mesocosms) were dosed daily with chlorine, resulting in average chlorine doses up to 261 micrograms/L. Protozoan species numbers were depressed at chlorine doses > or = 79 micrograms/L, and zooplankton density was affected at 24 micrograms/L. Algal biomass and total biomass were adversely affected at the highest chlorine level, 261 micrograms/L. Nontaxonomic measures were typically less sensitive than community structure responses to chronic chlorine stress. Estimated effect levels for both experiments overlapped; however, the response of specific variables (i.e., stimulation, inhibition, no effect) to chlorine differed between the two tests. These results support the importance of experimental design and dosage regime in chronic toxicity testing. (Author's abstract)
W89-04335

USING STREAM SURVEY DATA TO PREDICT DIRECTIONAL CHANGE IN FISH POPULATIONS FOLLOWING PHYSICOCHEMICAL STREAM PERTURBATIONS,
Kansas Dept. of Wildlife and Parks, Pratt. Environmental Services Section.
W. G. Layher, and O. E. Maughan.
Environmental Toxicology and Chemistry

ETOCDK, Vol. 7, No. 9, p 689-6, September 1988. 4 fig, 5 tab, 11 ref.

Descriptors: *Water pollution effects, *Environmental impact, *Habitats, *Stream profiles, *Fish populations, Central stoneroller, Regression analysis, Chemical composition, Model studies, Population dynamics.

Standing stocks of fish species were graphed against 30 abiotic variables measured in Kansas streams. The resulting habitat suitability curves for each variable allowed fish biomass to be normalized to index values that could be regressed linearly against these variables. Stepwise multiple-regression techniques isolated variables that accounted for much of the biomass of individual populations. Regression models applied to an independent data set from Oklahoma produced highly significant (though low) correlations between predicted and observed standing stocks. Assigning suitability index values to Oklahoma streams from curves developed with Kansas data identified other variables as limiting, thus explaining much of the biomass variation. This analysis indicated that the habitat suitability curves approximated fish population changes along a single variable axis. Kansas stream data has been placed in a statistical data set and provided with visual display. The system allows for rapid assessment of the effects of changes in 30 physicochemical variables on populations of about 100 fish species in Kansas streams. (Author's abstract)
W89-04336

APPLICATION OF CELLULOLYTIC ACTIVITY OF ASIATIC CLAMS (CORBICULA SP.) TO IN-STREAM MONITORING OF POWER PLANT EFFLUENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-04337

STRUCTURAL ALTERATIONS IN AQUATIC INSECT COMMUNITIES EXPOSED TO COPPER IN LABORATORY STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
W. H. Clements, D. S. Cherry, and J. Cairns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9, p 715-722, September 1988. 3 fig, 3 tab, 28 ref.

Descriptors: *Water pollution effects, *Toxicity, *Species composition, *Aquatic insects, *Copper, *Pollutants, Artificial streams, Heavy metals.

The effects of copper on aquatic insect communities were examined using rock filled trays colonized in the field for 30 days, transferred to laboratory streams, and dosed with CuSO4. Each stream was randomly assigned to one of three treatments: control (0 microg/L), low dose (15-32 microg/L), and high dose (135-178 microg/L). Experiments were replicated over three seasons. Exposure to copper for 96 hours significantly reduced both the total number of individuals and number of taxa during each season, with greatest effects observed in summer. Owing to differences in sensitivity to copper, the percent composition of dominant orders of aquatic insects varied among treatments. The relative abundance of Ephemeroptera decreased in treated streams during each season. The response of other aquatic insects, including Diptera and Plecoptera, varied between seasons, but these groups were generally less sensitive to copper exposure. These results indicate that the artificial substrates employed in this study are amenable to experimental manipulation and will provide a unique opportunity to examine the community responses of aquatic insects to toxicants under environmentally realistic conditions. (Author's abstract)
W89-04338

PREDICTING ACIDIFICATION EFFECTS ON FISH POPULATIONS, USING LABORATORY DATA AND FIELD INFORMATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. W. Christensen, J. E. Breck, and W. Van Winkle.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 9, p 735-747, September 1988. 5 fig, 2 tab, 28 ref.

Descriptors: *Acid rain, *Acid rain effects, *Water pollution effects, *Acidity, *Fish, *Mathematical models, Regional analysis, Aluminum, Calcium, Hydrogen ion concentration, Regression analysis, Trout, Population dynamics.

A framework of linked models was developed that uses lake levels of pH, Al, and Ca to predict the occurrence of fish species on a regional scale. Statistical models are fitted to laboratory data on brook trout (Salvelinus fontinalis). The resulting functions predict mortality and reduction in fecundity resulting from chemical conditions (pH, Al, and Ca). The second step applies a life cycle model to results from the first step to estimate the reproductive potential expected for fish living in lakes with specified chemical conditions relative to that expected for fish living under nonstressful chemical conditions. Use of the framework requires field data on the presence or absence of brook trout in lakes having measured pH, Al, and Ca. The chemical conditions for each lake are processed through the first two steps to estimate the relative reproductive potential for brook trout in that lake After obtaining estimates for all lakes, a logistic regression model is fitted, with probability of occurrence as the dependent variable and relative reproductive potential as the independent variable. The resulting function, representing the calibrated framework, relates the probability of brook trout occurrence in high elevation Adirondack (New York) lakes to relative (i.e., reduced) reproductive potential attributable to chemical stress. This function, when tested against additional data, can be used to predict changes in brook trout population status in relation to changed chemical conditions, stocking, or altered fishing pressure. (Author's abstract)
W89-04339

PHOTOOXIDATION PRODUCTS OF SMOKE GENERATOR FUEL (SGF) NO. 2 FOG OIL AND TOXICITY TO HYALLELA AZTECA,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W89-04341

LABORATORY ACIDIFICATION OF A CRUSTACEAN ZOOPLANKTON ASSEMBLAGE FROM A ROCKY MOUNTAIN SUBALPINE LAKE (U.S.A.),
Idaho National Engineering Lab., Idaho Falls. Center for Environmental Monitoring and Assessment.
D. A. Bruns, and G. B. Wiersma.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 807-814, October 1988. 3 fig, 3 tab, 27 ref.

Descriptors: *Water pollution effects, *Population dynamics, *Acid rain, *Zooplankton, *Lakes, Hydrogen ion concentration, Acidification, Daphnia, Crustaceans.

A laboratory acidification experiment was conducted with a Rocky Mountain zooplankton assemblage from a subalpine lake located downwind of energy development activities and significant sources of acid precursors. The objective of the study was to assess the relative effects of lowered pH (treatment pH 4.2 and 5.2, control pH 6.8) on the survival of different crustacean zooplankton species under controlled conditions for extended periods (10 to 41 days). Analysis of variance indicated statistically significant differences between controls and treatments (acid treatments contained fewer individuals than did controls) for all four species, and significant differences among species. Newmann-Keuls multiple range tests demonstrated the following ranking of species sensitivity (high to low) to a lowered pH of 5.2: Daphnia rosea>Holopedium gibberum>Diaptomus lintoni>Cyclops sp. At pH 4.2, H. gibberum was significantly more tolerant than D. rosea and D. lintoni, but no other significant differences were apparent. The results agree generally with those of other published experiments and field surveys. (Author's abstract)
W89-04344

CONCURRENT MOBILE ON-SITE AND IN SITU STRIPED BASS CONTAMINANT AND WATER QUALITY STUDIES IN THE CHOPTANK RIVER AND UPPER CHESAPEAKE BAY,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, S. J. Bushong, M. C. Ziegenfuss, S. W. Hall, and R. L. Herman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 815-0, October 1988. 16 tab, 1 fig, 23 ref.

Descriptors: *Water pollution effects, *Water quality, *Survival, *Bass, *Contamination, *Chesapeake Bay, Chesapeake and Delaware Canal, Organic compounds, Inorganic compounds, Fluoride, Sulfate, Aluminum, Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Tin, Zinc, Heavy metals, Chemical analysis, Larvae, Bays.

In situ and mobile on site striped bass prolarval and yearling survival studies were conducted in the Choptank River and in the Chesapeake and Delaware (C&D) Canal area of the Upper Chesapeake Bay. Chemical analyses of both organic and inorganic contaminants in the habitat water were performed and water quality parameters were monitored during these experiments. Surviving yearling striped bass were subjected to histological examination. Prolarval survival data from both the in situ and mobile on site studies were similar for each spawning area. Prolarval survival ranged from 30 to 45% after 96 hours of exposure to Choptank River water in four separate experiments (two in situ, two on site); control survival was greater than 74%. Based on a comparison of laboratory toxicity data and reported field concentrations in the Choptank River for various water quality and contaminant conditions, the following combination of conditions was potentially stressful to striped bass prolarvae: low hardness (36 to 48 mg/L CaCO3), monomeric aluminum (0.150 mg/L), cadmium (0.003 mg/L) and copper (0.40 mg/L). Yearling survival in both in situ and on site tests ranged from 93 to 100% in both the control and Choptank River water after 9 days of exposure. Survival of striped bass prolarvae in C&D Canal water ranged from 52.5 to 70% after 96 hours of exposure in four separate experiments. Control survival of prolarvae was not significantly different. Survival of yearling striped bass in on site and in situ tests was 95% or greater in C&D Canal water and control water. Acute contaminant effects were not verified in the C&D Canal area. (Author's abstract)
W89-04345

PORPHYRIA IN HERRING GULLS: A BIOCHEMICAL RESPONSE TO CHEMICAL CONTAMINATION OF GREAT LAKES FOOD CHAINS,
National Wildlife Research Centre, Ottawa (Ontario).
G. A. Fox, S. W. Kennedy, R. J. Norstrom, and D. C. Wigfield.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 831-839, October 1988. 2 fig, 3 tab, 39 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Gulls, *Great Lakes, Polyhalogenated aromatic hydrocarbons, Porphyria, Water birds, Lake Michigan, Lake Huron, Lake Ontario, Toxicity, Polychlorinated biphenyls, Pollutants.

Concentrations of highly carboxylated porphyrins (HCPs) in the livers of adult herring gulls (Larus argentatus) from colonies throughout the Great Lakes were found to be markedly elevated in comparison with those in gulls from coastal area and in seven other species of birds consuming diets uncontaminated with polyhalogenated aromatic hydrocarbons (PHAHs). The highest levels were found in gulls from lower Green Bay (Lake Michi-

gan), Saginaw Bay (Lake Huron) and Lake Ontario. It is suggested that the high levels of HCPs reflect PHAH induced derangement of heme biosynthesis. Determination of HCPs offers promise as a specific and sensitive biological marker of PHAH induced toxicity and as a measure of the toxicological significance of the chemical burden in gulls, terminal members of Great Lakes food chains. (Author's abstract)
W89-04346

ACUTE TOXICITY OF CHLOROPHENOLS TO GREEN ALGAE, SELENASTRUM CAPRICORNUTUM AND CHLORELLA VULGARIS, AND QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS,
Mitsubishi-Kasei Inst. of Toxicological and Environmental Sciences, Yokohama (Japan).
T. Shigeoka, Y. Sato, Y. Takeda, K. Yoshida, and F. Yamauchi.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 10, p 847-854, October 1988. 4 fig, 4 tab, 21 ref.

Descriptors: *Water pollution effects, *Chlorinated hydrocarbons, *Algae, *Toxicity, *Chlorophenols, Physicochemical properties, Selenastrum capricornutum, Chlorella vulgaris, Molecular parameters, Structure activity relationship.

The growth inhibition (96-hour EC50) of two species of green algae, Selenastrum capricornutum and Chlorella vulgaris, caused by phenol and 12 chlorophenols (from mono-Cl to penta-Cl) was determined according to the Organization for Economic Cooperation and Development guidelines for testing chemicals. The responses of the algae to the chemicals were measured by cell counting, and 96-hour EC50 values were correlated with six physicochemical parameters of chlorophenols. The parameters employed in the quantitative structure-activity relationship (QSAR) analyses were n-octanol/water partition coefficient (log Pow), dissociation constant (pKa), Hammett sum of the sigma constant, index of valence molecular connectivity, perimeter of the efficient cross section of molecule and melting point. In the S. capricornutum assay, the toxicity increased as the number of substituted chlorine atoms increased. In the C vulgaris assay, although toxicity increased from phenol to dichlorophenol, the toxicities of di-, tri-, tetra-, and pentachlorophenol were almost the same. QSAR study shows that log Pow gives the best correlation, even in the C. vulgaris assay, by the use of the square of log Pow. Therefore, the growth inhibition of these algae caused by chlorophenols is mostly influenced by lipophilicity, as is stated frequently in toxicity studies using aquatic animals. (Author's abstract)
W89-04347

WHOLE ECOSYSTEM MANIPULATION: A PRODUCTIVE AVENUE FOR TEST SYSTEM RESEARCH,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
J. A. Perry, and N. H. Troelstrup.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 11, p 941-1, November 1988. 6 fig, 1 tab, 60 ref.

Descriptors: *Environmental impact, *Water pollution effects, *Acid rain effects, *Ecosystems, *Stress, Acidification, Fungi, Chlorine, Ammonia, Ecosystem manipulation, Minnesota, Leaf litter, Literature review, Leaves, Biodegradation, Temperature.

Single species, microcosm and mesocosm toxicity tests have been shown to be inadequate in assessing impacts on whole ecosystems, yet effective environmental management requires attention to such impacts. Whole ecosystem manipulation provides community and ecosystem level assessment, but is expensive and logistically demanding. The results of two whole ecosystem experiments (dosing of stream channels with chlorine and ammonia and acidification of a lake) are presented and several other such experiments from the literature are reviewed. In 1985, a project was initiated to examine the effects of chlorine and ammonia on the freshwater communities of the Monticello stream channels. There was a reduction in the rate of weight loss in leaf litter bags exposed to chlorine and chlorine plus ammonia. Changes in the rate of weight loss coincided with reductions in the number and activity of macroinvertebrate shredders. The Little Rock Lake experimental acidification was a whole ecosystem manipulation that posed questions about direct versus indirect effects of acidification. The manipulation consisted of dividing the lake at the isthmus with an impermeable barrier and then lowering the pH of one basin. There were significantly more fungi on south basin oak leaves than on lake leaves from the acidified north basin. Most whole ecosystem studies are complex, expensive, involve multiple investigators and have a low degree of true replication. Difficulty in replicating whole system manipulations makes quantifying cause-effect relationships difficult, but this can be partially overcome by carefully developing the inferences from an investigation. It is suggested that such experiments represent a useful test system and that they are the only acceptable way of discerning impacts at the community and ecosystem levels. (Davis-PTT)
W89-04351

QUANTIFYING RISKS OF TOXIC CHEMICALS TO AQUATIC POPULATIONS AND ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
L. W. Barnthouse, G. W. Suter, and S. M. Bartell.
Chemosphere CMSHAF, Vol. 17, No. 8, p 1487-1492, 1988. 24 ref.

Descriptors: *Water quality control, *Risk assessment, *Chemical wastes, *Toxicity, *Aquatic environment, *Aquatic populations, Pesticides, Regulations, Mathematical models, Environmental effects, Statistics, Water quality, Pollutants.

The objectives of regulatory practice have evolved from eliminating all risks of pesticides and toxic chemicals to the environment to reducing risks to acceptable levels. This change in philosophy requires the development of methods for quantifying the risks of toxicant exposure to the exposed biota. Ecological risk assessment models that are comparable to those used in human health risk assessment have been developed using methods drawn from ecotoxicology, ecology, statistics, and mathematical modeling. Initial applications have shown that the regulation of pesticides and toxic chemicals can be substantially improved through the use of ecological risk assessment. (Author's abstract)
W89-04354

PROPOSED METHOD FOR CALCULATING TAXONOMIC-GROUP-SPECIFIC VARIANCES FOR USE IN ECOLOGICAL RISK ASSESSMENT,
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W89-04355

STRUCTURE ACTIVITY RELATIONSHIPS FOR ENVIRONMENTAL PROCESSES 1. HYDROLYSIS OF ESTERS AND CARBAMATES,
Wisconsin Univ., Madison. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-04356

LAKE ACIDITY AND THE DISTRIBUTION AND ABUNDANCE OF WATER STRIDERS (HEMIPTERA: GERRIDAE) NEAR SUDBURY, ONTARIO,
Canadian Wildlife Service, Ottawa (Ontario).
B. E. Bendell.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 10, October 1988, p 2209-2211. 2 fig, 19 ref.

Descriptors: *Aquatic insects, *Ontario, *Acid rain effects, *Water pollution effects, *Acidity, *Lakes, Water pollution, Acidic water, Canada, Hydrogen ion concentration, Fish, Water striders, Correlation analysis.

The presence of major water strider species was recorded in a survey of 53 lakes covering a wide range of acidity near Sudbury, Ontario. The mean pH of lakes on which Metrobates hesperius and Trepobates inermis were found at pH < 5.1. There was no evidence that the distributions of Gerris spp. were related to lake acidity. Quantitative sampling was undertaken to examine the relationship between the abundance of Rheumatobates rileyi and lake acidity and any other concomitant relationship to fish. A highly significant positive relationship was found between densities of R. rileyi and lake pH, but no relationship was found with the presence or absence of fish. (Author's abstract)
W89-04387

STUDIES ON THE STABILITY OF N-CHLORO-AMINOACIDS: DECOMPOSITION OF N-CHLORO-L-SERINE,
Santiago Univ. (Spain). Dept. de Quimica Fisica.
For primary bibliographic entry see Field 5F.
W89-04396

BIOLOGICAL IMPLICATIONS OF SEASONAL AND URBAN NITRATE (ACID) WET DEPOSITION,
Cincinnati Univ., OH.
J. A. M. Schultz.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 713-720, July 1988. 4 tab, 25 ref.

Descriptors: *Acid rain effects, *Nitrogen, *Sulfur, *Nitrates, *Policy making, *Acid rain, *Water pollution sources, Deforestation, Coal, Coal use, Political aspects, Urban aeas, Baseline studies.

Oxides of nitrogen and sulfur have been considered the chief precursors of acid precipitation. Increases in these precursors are expected through the year 2000 from projected increases in coal use due to continued political vulnerability of middle-eastern oil, and from dwindling domestic supplies in the U.S., as well as from increasing mobile sources. Nitrates have been recently linked to massive forest destruction in Europe and in the U.S. The need is demonstrated for increased baseline research on nitrates and for new monitoring approaches based upon examination of national data, while interfacing these needs with new policy and control strategies. (Author's abstract)
W89-04404

MYTILUS EDULIS AS A QUANTITATIVE INDICATOR OF DISSOLVED CADMIUM: FINAL STUDY AND SYNTHESIS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5A.
W89-04424

WATER QUALITY CHARACTERISTICS AND PHYTOPLANKTON OF POLLUTED VISAKHAPATNAM HARBOUR,
Andhra Univ., Waltair (India). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W89-04428

EFFECT OF INHERITED CONTAMINATION ON EGG AND LARVAL WINTER FLOUNDER, PSEUDOPLEURONECTES AMERICANUS,
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
D. E. Black, D. K. Phelps, and R. L. Lapan.
Marine Environmental Research MERSDW, Vol. 25, No. 1, p 45-62, 1988. 5 fig, 3 tab, 34 ref.

Descriptors: *Estuaries, *Water pollution effects, *Polychlorinated biphenyls, *Toxicity, *Flounders, *Growth stages, Fish eggs, Larvae, Rhode Island, Massachusetts, Hatching.

The exposure of adult winter flounder, Pseudopleuronectes americanus, to contaminated estuarine environments and a possible impact of this exposure on their progeny was investigated. Polluted study areas included Gaspee Point in upper Narragansett Bay, RI, New Bedford Harbor in

Buzzards Bay, MA, noted for its PCB (polychlorinated biphenyl) contamination, and Apponagansett Bay, MA, a less contaminated site near New Bedford. Fox Island, a relatively clean area in lower Narragansett Bay, served as a reference area. Although adult winter flounder disperse offshore during the summer, a tag and recapture study verified their yearly residence and exposure to contaminants at Gaspee Point during the spawning season. A similar migratory pattern was assumed for Buzzards Bay fish. Growth, survival and contaminant residues were measured in the progeny of fish collected from the study areas. Eggs from New Bedford Harbor flounder contained significantly higher levels of PCB (39.6 micrograms/g dry weight), and larvae which hatched from these eggs, under clean laboratory conditions, were significantly smaller in length (2.96 mm) and weight (0.018 mg) than those for Fox Island (1.08 micrograms PCB/g dry weight, 3.22 mm, 0.022 mg). Linear aggression analysis indicated a significant inverse relationship between PCB content of the eggs and length or weight at hatch. Small size at hatch may have severe consequences since the best survival strategy is rapid growth. Small larvae are inefficient predators and, at the same time, are more vulnerable to predation. (Brock-PTT)
W89-04429

TOXICITY OF MARINE SEDIMENTS SUPPLEMENTED WITH MIXTURES OF SELECTED CHLORINATED AND AROMATIC HYDROCARBONS TO THE INFAUNAL AMPHIPOD RHEPOXYNIUS ABRONIUS,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
P. D. Plesha, J. E. Stein, M. H. Schiewe, B. B. McCain, and U. Varanasi.
Marine Environmental Research MERSDW, Vol. 25, No. 1, p 85-97, 1988. 2 fig, 2 tab, 25 ref.

Descriptors: *Marine sediments, *Hydrocarbons, *Toxicity, *Amphipods, *Bioaccumulation, *Water pollution effects, Washington, Chlorinated hydrocartbons, Sediments, Bioassay.

The toxicity of a reference sediment supplemented with mixtures of seven aromatic hydrocarbons (fluoranthene, phenanthrene, benz(a)anthracene, benzo(a)pyrene (BaP), 2,6-dimethylnaphthalene (DMN), 1-methylnaphthalene, and 2-methylnaphthalene) or 4 chlorinated hydrocarbons (polychlorinated biphenyls (PCBs, Aroclor 1254), hexachlorobutadiene, 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane and hexachlorobenzene) was evaluated in amphipod (Rhepoxynius) lethality bioassays. Significant mortality occurred among amphipods exposed for 10 days to a reference sediment (46% fines, 0.9% total organic carbon) supplemented with a mixture of chlorinated hydrocarbons at concentrations (0.05-1.0 micrograms/g dry wt) approximating those measured in contaminated sediments of Puget Sound, WA, as well as at concentrations 5 times as great (5x). In contrast, sediments supplemented with the aromatic hydrocarbon mixture were toxic only at the higher (5x) concentrations (0.5-15.0 micrograms/g dry wt). Sediment concentrations of the mixture components and their bioavailability to amphipods were assessed using radiolabeled PCBs, DMN and BaP. Measurement of radioactivity incorporated by R. abronius after the 10-day exposure period indicated a dose-related uptake of xenobiotic compounds from both the chlorinated and aromatic hydrocarbon-supplemented sediments. Dimethylnaphthalene and the metabolically refractive PCBs were bioaccumulated to a greater extent than BaP, which is known to be metabolized extensively by R. abronius. (Author's abstract)
W89-04431

IN SITU MODELING OF THE EFFECT OF POLLUTANTS ON PRODUCTION OF ORGANIC MATTER BY PHYTOPLANKTON,
Akademiya Nauk URSR, Odessa. Inst. Ekonomiki.
S. A. Sarkisova, and I. A. Skripnik.
Oceanology ONLGAE, Vol. 27, No. 2, p 171-173, October 1988. 3 fig, 4 ref.

Descriptors: *Water pollution effects, *Toxicity, *Phytoplankton, *Seawater, *Marine algae, Primary productivity, Surfactants, Chlorine, Fuel, Organic matter, Black Sea.

The effects of three categories of pollutants, i.e., diesel fuel, surfactants and chlorine, on the production properties of natural microalgal populations was studied in specific volumes of sea water isolated in plastic containers from the Black Sea. The pollutants were ranked by toxicity on the basis of single-factor experiments as follows: chlorine wass the most toxic substance while the differences in the toxic effects of the surfactants and the diesel fuel were only slight. An idea of the effect of pollutant mixtures is obtained from multifactor experiments, which suggested that the effect of the mixtures is related less to the concentrations of the individual toxicant than to their combination. Decreasing the volume of the model containers, aggravated the toxic effect. (Author's abstract)
W89-04433

SEASONAL ASPECTS OF POTENTIAL LIMITATION BY N, P AND FE ON PHYTOPLANKTON IN BARRA BONITA RESERVOIR (RIVER TIETE, SP) (ASPECTOS SAZONAIS DA LIMITACAO POTENCIAL POR N, P, E FE NO FITOPLANCTON DA REPRESA DE BARRA BONITA (RIO TIETE, SP)),
Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-04437

RESPONSE OF XANTHIUM STRUMARIUM L. TO SIMULATED ACID RAIN,
Western Kentucky Univ., Bowling Green. Dept. of Biology.
J. E. Winstead, and L. S. Strange.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 49, No. 1/2, p 29-31, March 1988. 2 tab, 14 ref.

Descriptors: *Acid rain, *Acid Rain effects, *Weeds, *Simulated rainfall, *Chlorophyll, *Hydrogen ion concentration, Baseline studies, Biomass, Chlorophyll, Plant physiology, Plant tissues, Leaves, Light intensity.

A study was designed to provide baseline data on the effect of acid rain on a geographically-widespread weedy species common to a variety of habitats. A population of the common cocklebur from east-central Texas was chosen to provide genomes that have had little exposure to acid rain conditions in recent years. Foliage treated with simulated precipitation of pH 4.5, 3.5, and 2.5 compared with controls subject to artificial rain of pH 5.6 showed a reduction of dry-weight biomass between 21.8 and 27.5%. While no indication of reduced caloric content was found, significant declines in total chlorophyll levels were detected in plants treated with regulated artificial rain of pH 3.5 and 2.5. This reduction in chlorophyll levels under the 2 more acidic treatments suggests a possible mechanism of lowered carbon fixation and indicates the need for further research to determine the actual physiological effects of acidic moisture on leaf tissue. Reductions in cuticular deposits on leaf surfaces by acidic solutions could result in decreased chlorophyll production in nature since high light intensity will interfere with chlorophyll synthesis. (Shidler-PTT)
W89-04441

EFFECT OF DOMESTIC SEWAGE AND INDUSTRIAL EFFLUENTS ON BIOMASS AND SPECIES DIVERSITY OF SEAWEEDS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
A. Tewari, and H. V. Joshi.
Botanica Marina BOTNA7, Vol. 31, No. 5, p 389-397, September 1988. 1 fig, 11 tab, 33 ref.

Descriptors: *Coastal waters, *Water pollution effects, Municipal wastewater, Industrial wastewater, *Algae, *Species diversity, *Wastewater, Environmental effects, Biomass, Municipal wastewater, Effluents, Water pollution, Spatial distribution, Vertical distribution, India, Productivity, Outfall.

The effect of two chlor-alkali industry effluents and domestic sewage was studied on tropical seaweeds of the Okhamandal coast, India. Maximum biomass was observed at a distance of 400 and 5,000 m away from the discharge points of the two chlor-alkali industries. Ulva lactuca and Rhizoclonium kochianum were most resistant while Caulerpa scalpelliformis, Halimeda tuna, and Codium dwarkense were most sensitive. Species of Sargassum, Cystoseira, and Gelidiella were completely eradicated due to the long term effect of the effluent from one chlor-alkali industry. Gracilaria corticata, G. foliifera, and species of Hypnea produced good biomass under mildly polluted conditions, and they may be cultivated in such areas. Algal species diversity increased as the distance from the outfall increased. In general, brown seaweeds were most sensitive to this type of pollution. Domestic sewage was much less inhibitory to seaweeds. Species of Ulva and Enteromorpha were maximum biomass producers, while brown seaweeds were least productive near the discharge. Species diversity was high. Vertical distribution of seaweeds was not evident up to 400-4,000 m away from chlor-alkali outfalls and up to 10 m away from domestic sewage discharge points. Seaweeds showed characteristic vertical distribution after these distances. (Author's abstract)
W89-04477

EXPERIMENTAL STUDIES OF CHEMICAL STRESSORS ON WHOLE LAKE ECOSYSTEMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 11-41, January 1988. 11 fig, 6 tab, 119 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Lakes, *Aquatic environment, Ecological effects, Rainfall, Metabolism, Nutrients, Cycling nutrients, Physiological ecology, Phytoplankton, Aquatic plants, Aquatic productivity, Decomposition, Canada, Acidity, Literature reviews, Field tests, Mesocosms, Chemical properties, Ecology, Acid rain, Eutrophication.

Experimental studies of chemical stressors on whole-lake ecosystems are reviewed, based on research carried out at the Experimental Lakes Area (ELA) in Ontario, Canada. Experiments with both nutrients and strong acids have made it clear that an ecosystem's response to pollutants can be extremely complex. Topics discussed include the effect of acidification on the metabolism and nutrient cycles, changes in the biotic community, eutrophication experiments, comparison of whole-ecosystem experiments with smaller-scale approaches of evaluating ecosystem stress, small-scale laboratory experiments, mesocosm scale experiments, paleolimnological calibrations, natural variation and the misinterpretation of results, and extrapolation of Experimental Lake results to other areas. Long-term goals at ELA include a comparison of stresses of different types on lakes and other ecosystems, biogeochemical control of lake chemistry, and the design of whole-ecosystem experiments. It is concluded that experimental manipulation of lake ecosystems has helped correct misconceptions about the metabolism and communities of lakes, and provides important information for protecting our ecosystem. (Doria-PTT)
W89-04478

REGAINED, BUT HIDDEN HOLOMIXIS OF THE AUSTRIAN LAKE TRAUNSEE,
Innsbruck Univ. (Austria). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W89-04481

SEASONAL DYNAMICS OF SULFATE AND HYDROGEN SULFIDE NEAR THE SEDIMENT-WATER INTERFACF OF AN OLIGOTROPHIC LAKE,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).

For primary bibliographic entry see Field 2H.
W89-04487

HAS SILICA INCREASED IN LAKE SUPERIOR WATERS,
Florida Univ., Gainesville. Dept. of Fisheries and Aquaculture.
C. L. Schelske, D. J. Conley, and E. F. Stoermer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 163-169, January 1988. 3 fig, 15 ref. NSF grant DPP 8505557.

Descriptors: *Acid rain effects, *Limnology, *Silica, *Lake Superior, *Lakes, *Diatoms, *Phosphorus, *Water pollution effects, Sedimentation, Industrial wastes, Mine wastes, Acidity, Waste disposal, Leaching, Sediments, Chemical properties.

The increase in biogenic silica and soluble Si concentration in Lake Superior was investigated. Data support the conclusion that an increase in Si concentration of at least 0.20 mg/l occurred between the early 1970s and 1986 in the lake. Data also indicate that permanent sedimentation of biogenic silica may have increased 2- or 3-fold in recent sediments. However, data from only 3 of 4 cores support the hypothesis that sedimentation of biogenic silica has increased because of increased diatom production resulting from phosphorus enrichment. Therefore, the observed increases in Si concentration in water and biogenic silica in sediments requires an increase in external loads of Si. It is suggested that the two most likely sources are increased rates of mineralization of silicate minerals as the result of recent increases in acidity of precipitation and the disposal of taconite tailings by Reserve Mining Co. at Silver Bay, Minnesota. (Doria-PTT)
W89-04494

EXAMPLES OF CHANGES IN WATER CHEMISTRY DURING LAKE ACIDI- AND 'DEACIDIFICATION',
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-04498

EFFECT OF OXYGEN DEPLETION ON THE TIMING AND MAGNITUDE OF BLUE-GREEN ALGAL BLOOMS,
Alberta Univ., Edmonton. Dept. of Zoology.
A. M. Trimbee, and E. E. Prepas.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 220-226, January 1988. 2 fig, 2 tab, 34 ref.

Descriptors: *Limnology, *Oxygen depletion, *Eutrophication, *Algae, *Lake sediments, Depletion, Lakes, Trophic level, Cyanophyta, Sediments, Phosphorus, Biomass, Iron, Aeration.

A study was undertaken to evaluate whether the timing and extent of oxygen depletion over lake sediments could serve as predictors of the timing and magnitude of summer blue-green algal blooms in freshwater temperate lakes. Data on the extent of oxygen depletion over lake sediments, mean depth, trophogenic and total phosphorus, and the relative biomass of blue-green algae were collected from 39 lakes. Three patterns emerged with respect to the relative potential for recruitment of blue-green algae ((OXYD) = proportion of sediments overlain by oxic water *Z): (1) blue-green algal biomass increased as OXYD decreased, even though trophogenic total phosphorus did not increase until after maximum blue-green algal biomass occurred; (2) blue-green algal biomass increased as OXYD decreased prior to an increase in the trophogenic zone; and (3) blue-green algal biomass increased coincident with a decrease in OXYD and an increase in total phosphorus in the trophogenic zone. It is concluded that the relative potential for blue-green algal recruitment influences the relative biomass of blue-green algae. This is consistent with observations that dissolved oxygen depletion over the sediments favors the recruitment of blue-green algae. (Doria-PTT)
W89-04501

SOURCES FOR INTERNAL P LOADING IN A SHALLOW LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W89-04510

GREAT LAKES ECOSYSTEM EXPERIMENT,
Wisconsin Univ.-Madison. Sea Grant Inst.
For primary bibliographic entry see Field 2H.
W89-04514

RECENT HUMAN INFLUENCES ON THE ECOLOGY OF LOCH LOMOND, SCOTLAND,
Paisley Coll. of Tech. (Scotland). Dept. of Biology.
For primary bibliographic entry see Field 4C.
W89-04520

GONYOSTOMUM SEMEN-A NEW NUISANCE TO BATHERS IN NORWEGIAN LAKES,
National Inst. of Public Health, Oslo (Norway).
D. Hongve, O. Lovstad, and K. Bjorndalen.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 430-434, January 1988. 4 fig, 6 ref.

Descriptors: *Flagellates, *Gonyostomum, *Lakes, *Swimming, *Public health, *Eutrophication, *Norway, Trophic level, Phytoplankton, Plankton, Aquatic plants, Water quality, Water quality management, Algicides, Pesticides, Copper sulfate, Nutrients, Acidity, Color, Optical properties, Biomass.

The increasing density of the green flagellate Gonyostomum semen may become a nuisance to bathers in Norwegian lakes. The mucilaginous threads stick to the skin and may form a slimy coating that has to be washed off after bathing. Cases of allergic reaction have also been reported. The history of occurrence of Gonyostomum in Norway is reviewed, and its occurrence and biomass are described with relation to water quality. It is concluded that Gonyostomum seems to thrive best in rather small lakes with pH 5-7, high water color, moderately high phosphorus concentration, and low inorganic nitrogen concentration. Changing one or more of these conditions might reduce the biomass of Gonyostomum; however, these factors cannot be changed by simple methods. The use of copper sulfate as an algicide seems to be the only reliable way to control Gonyostomum. Aeration of the lake with a mixture of air and ozone may also be effective. A full-scale experiment is planned with the air-ozone treatment. (Doria-PTT)
W89-04522

ANNUAL CARBON FLUXES BETWEEN PHYTO-, ZOO-, AND BACTERIO-PLANKTON IN EUTROPHIC, LAKE FREDERIKSBORG SLOTSSO, DENMARK,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
A.-M. Jespersen, K. Christoffersen, and B. Riemann.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 440-444, January 1988. 3 fig, 18 ref.

Descriptors: *Limnology, *Carbon cycle, *Eutrophic lakes, *Eutrophication, *Phytoplankton, *Zooplankton, *Aquatic bacteria, *Productivity, Lakes, Denmark, Distribution, Annual distribution, Bacteria, Plankton, Aquatic plants, Trophic level, Fish, Ecology.

The annual rate of phytoplankton primary production was compared with direct estimates of carbon channeled through bacteria and macrozooplankton in Lake Frederiksborg Slotsso (Denmark), a eutrophic temperate lake. Out of the phytoplankton net primary production (393 g/sq m/yr), 51% was channeled through the bacterioplankton and 26% through the macrozooplankton. Only about 5% of the bacterial production was channeled through the macrozooplankton. The rest of the bacterial production was probably grazed by microflagellates. The remaining phytoplankton primary production (89 g C/sq m/yr) was probably lost via sedimentation and through grazing by zooplankton and planktivorous fish. It is assumed that a maximum of 5% of the bacterial production was sustained via zooplankton activities corresponding to about 10% of the zooplankton ingestion. The overall budget supports the idea that the major part of the phytoplankton primary production is channeled through bacteria in eutrophic temperate lakes and only a minor part of the bacteria is food for macrozooplankton. (Doria-PTT)
W89-04524

RELATIONS BETWEEN CHEMISTRY, MICROBIAL BIOMASS AND ACTIVITY IN SEDIMENTS OF A SEWAGE-POLLUTED VS A NONPOLLUTED EUTROPHIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-04526

ECOLOGICAL INVESTIGATIONS IN THREE SHALLOW LAKES OF DIFFERENT TROPHIC LEVEL IN THE NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands). Lab. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W89-04529

PHOSPHORUS METABOLISM AND EUTROPHICATION CONTROL OF LAKE BALATON,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5G.
W89-04530

EUTROPHICATION OF LAKES AND RESERVOIRS IN ITALY,
Istituto di Ricerca sulle Acque, Brugherio (Italy).
For primary bibliographic entry see Field 5G.
W89-04533

INFLUENCE OF RECREATION, MAINLY POWER BOATING, ON THE ECOLOGY OF THE THIRLMERE LAKES, N.S.W., AUSTRALIA,
Macquarie Univ., North Ryde (Australia). School of Environmental Studies.
L. Horsfall, A. Jelinek, and B. V. Timms.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 580-587, January 1988. 1 fig, 3 tab, 12 ref.

Descriptors: *Water pollution control, *Water pollution effects, *Lakes, *Ecological effects, *Thirlmere Lakes, *Australia, *Boating, *Recreation, Limnology, Physical properties, Chemical properties, Biological properties, Sediments, Lead, Heavy metals, Fish, Gambusia, Trophic level, Erosion, Turbidity, Color, Nutrients.

The influence of recreation on the Thirlmere Lakes, which lie in a small national park near Sydney, Australia, is discussed. Power boating is having a marginal adverse effect on Lake 2, despite a scarcity of waterfowl during boating activity. Some lead has accumulated in the sediments, but not at hazardous levels. The biota seems not to be directly affected, though phytoplankton biomass is sometimes elevated. This increased biomass has probably contributed to the higher benthic standing crop in Lake 2. The introduced fish Gambusia affinis has probably greatly affected the structure and abundance of littoral invertebrates. However, this is difficult to quantify and to separate from the effect of environmental factors. The eroding picnic areas are contributing to minor deterioration of the physiochemical milieu of Lakes 2 and 3, mainly by increasing turbidity, color, and nutrients. This pro-

motes greater stratification and deoxygenation of bottom waters. Furthermore, the detritus carried into the lakes has had a minor local effect on the benthos. It is recommended that power boating be phased out over a two-year period and that conservation and monitoring activities be undertaken. (Doria-PTT)
W89-04536

LIMITATION TO THE USEFULNESS OF CHLOROPHYLL AS A BIOMASS INDICATOR IN EUTROPHICATION STUDIES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 7B.
W89-04538

PHOSPHORUS REDUCTION REQUIRED TO CONTROL EUTROPHICATION AT LAKE ROTORUA, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 5G.
W89-04540

EFFECTS OF WIND ON NITROGEN, PHOSPHORUS, AND CHLOROPHYLL IN A SHALLOW NEW ZEALAND LAKE,
Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-04543

RESPONSE OF COD (GADUS MORHUA) LARVAE AND JUVENILES TO OIL EXPOSURE DETECTED WITH ANTI-COD CYTOCHROME P-450C IGG AND ANTI-SCUP CYTOCHROME P-450E MAB 1-12-3,
Bergen Univ. (Norway). Dept. of Biochemistry.
A. Goksoyr, B. Serigstad, T. S. Solberg, and J. J. Stegeman.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 31-35. 2 fig, 13 ref.

Descriptors: *Toxicity, *Enzymes, *Water pollution effects, *Oil pollution, *Juvenile growth stage, *Larval growth stage, *Fish, *Immunology, Seawater, Scup, Cod, Monitoring, Cytochrome P-450.

Cytochrome P-450c (Mr = 58000 D) is the major cytochrome P-450 isozyme inducible by beta-naphthalene in cod (Gadus morhua) liver. Polyclonal rabbit IgG against this form was used as an immunochemical probe to detect responses of cod larvae and juveniles to oil exposure. In addition, monoclonal mouse antibodies against the homologous isozyme in scup (Stenotomus chrysops), scup cytochrome P-450E, were employed. The eggs, larvae and juveniles were reared and exposed in a system allowing controlled dosage of the water-soluble compounds from crude North Sea oil. The immunochemical response, measured with Western blotting and ELISA, in the liver of juveniles and in homogenates of whole larvae, reflected the exposure in a dose-dependent way. Larvae and juveniles that were allowed to recover in clean sea water, showed a decline towards the control levels within a few days. It is shown that cod larvae do respond to oil exposure with induced synthesis of the cytochrome P-450c isozyme, and that immunochemical detection of this induction can be a convenient tool for monitoring the pollution of aquatic environments. (Author's abstract)
W89-04544

IMMUNOHISTOCHEMICAL LOCALIZATION OF CYTOCHROME P-450E IN LIVER, GILL AND HEART OF SCUP (STENOTOMUS CHRYSOPS) AND RAINBOW TROUT (SALMO GAIRDNERI),
West Virginia Univ. Medical Center, Morgantown. Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W89-04545

FISH HEPATOCYTE MODEL FOR THE INVESTIGATION OF THE EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
S. M. Baksi, and J. M. Frazier.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 141-145. 2 fig, 2 ref.

Descriptors: *Toxicity, *Water pollution effects, *Fate of pollutants, *Path of pollutants, *Model studies, *Contamination, *Comparison studies, *Environmental effects, *Fish, Bass, Kinetics, Proteins, Metal-binding proteins, Encymes, Invitro tests.

An isolated fish hepatocyte culture system was developed as a model system to investigate the mechanisms of action of environmental contaminants. Hepatocytes were isolated from striped bass (Morone saxatilis) by an adaptation of the two stage perfusion technique of Seglen. The system was used to evaluate metal binding protein induction response in cadmium, a primary inducer of metallothionein in rat hepatocytes. Striped bass hepatocytes appeared to be refractory to the induction of metal binding protein by cadmium, since was no significant increase in the synthesis of metal binding protein for any of the doses at any of the time points investigated. However, when a similar experiment was performed using rat hepatocytes there was induction of metal binding protein that was related to both dose and time. These comparative experiments indicate that although there are similarities between the hepatocytes of the two species in regard to S35 incorporation into low molecular weight metal-bonding protein, there appear to be significant quantitative differences as well in regard to metal binding protein kinetics. This in vitro model system could potentially by used to investigate the toxicological properties of other environmental contaminants. (Author's abstract)
W89-04547

PRESENCE OF ZN,CU-BINDING PROTEIN IN LIVER OF FRESHWATER FISHES IN THE ABSENCE OF ELEVATED EXOGENOUS METAL: RELEVANCE TO TOXIC METAL EXPOSURE,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
S. Krezoski, J. Laib, P. Onana, T. Hartmann, and P. Chen.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 147-150. 2 tab, 5 ref. Milwaukee NIH Marine and Freshwater Biomedical Core Center Grant ES-01985.

Descriptors: *Water pollution effects, Path of pollutants, *Zinc, *Cadmium, *Liver, *Fish, *Toxicity, *Metals, Heavy metals, Proteins.

To understand the place of metal-bonding proteins in normal and toxic metal metabolism, studies have examined the generality of its presence in freshwater fishes in the absence of excessive metal exposure, how their chemical properties compare with metallothionein, and the nature of their role in host response to cadmium-exposure. Cytosols from livers of 11 freshwater fishes contain large amounts of a 10000 Da metal-binding protein containing zinc and copper. Very little cadmium accumulates in this fraction in liver after 12 months exposure of rainbow trout to 9 microg/L cadmium in water. Much more cadmium is found in the Zn,Cu,Cd-binding protein in kidney. Characterization of fish-binding protein showed that in vitro cadmium added to cytosol displaces zinc but not copper. The ratio of sulfhydryl to zinc and copper is 2.3-2.6. Copper is bound in the 1+ state and is removed by bathocuproine disulfonate. By these criteria, the binding protein behaves like metallothionein. (Miller-PTT)
W89-04548

METALLOTHIONEIN AND HEAVY METAL LEVELS IN RAINBOW TROUT (SALMO GAIRDNERI) DURING EXPOSURE TO CADMIUM IN THE WATER,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
P.-E. Olsson, A. Larsson, and C. Haux.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 151-153. 1 tab, 8 ref.

Descriptors: *Water pollution effects, Path of pollutants, *Heavy metals, *Cadmium, *Fish, *Trout, Liver, Kidney, Gills, Metallothionein.

Rainbow trout were exposed to 200 ppb cadmium in the water during four months at 5 C. The liver, kidney and gills were analyzed for cadmium, copper, zinc and metallothionein. Cadmium accumulated in all three organs and reached the highest concentration in the kidney. The zinc and copper concentrations were not altered during the experiment. The metallothionein concentration was significantly higher in liver of exposed fish than in control fish after three months. The kidneys reached significantly elevated levels of metallothionein in the exposed group after four months. These results demonstrate that metallothionein is induced by cadmium after exposure to the metal via water. (Author's abstract)
W89-04549

REPRODUCTIVE ENDOCRINE FUNCTION IN FEMALE ATLANTIC CROAKER EXPOSED TO POLLUTANTS,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
P. Thomas.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 179-183. 2 fig, 5 ref. EPA Grant R-812797 and NIEHS Grant ES04214.

Descriptors: *Water pollution effects, *Toxicity, *Lead, *Fish, *Aromatic compounds, *Aroclors, *Endocrine effects, *Croaker.

To examine whether xenobiotics impair reproduction by altering reproductive endocrine function, steroid hormone secretion and ovarian growth were investigated in female Atlantic croaker (Micropogonias undulatus) after chronic oral administration with sublethal doses of three classes of reproductive toxins (lead, benzo(a)pyrene and Aroclor 1254). All the sublethal treatments significantly impaired ovarian growth as assessed by the gonadosomatic index. Reduced ovarian growth was accompanied by a significant decline in circulating 17 beta-estradiol levels in fish exposed to lead and benzo(a)pyrene. All three toxicants significantly decreased plasma testosterone levels. However, the steroidogenic capacity of ovarian tissue in vitro was not altered by xenobiotic exposure. The data suggest that the decreased ovarian growth in croaker after pollutant exposure may be a consequence of the decline in plasma 17 beta-estradiol levels. Further, this decrease in circulating levels of gonodal steroids does not appear to be caused by a direct effect of the chemicals on ovarian steroid synthesis. (Author's abstract)
W89-04550

EVIDENCE FOR IMPAIRED REPRODUCTION IN WHITE CROAKER (GENYONEMUS LINEATUS) FROM CONTAMINATED AREAS OFF SOUTHERN CALIFORNIA,
Southern California Coastal Water Research Project, Long Beach.
J. N. Cross, and J. E. Hose.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 185-188. 1 tab, 11 ref. NOAA Grant no. NA-85-ABD-00003.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Water pollution effects, *Fish, *Spawning, *California, Contamination, Croaker, Fertilization, Los Angeles, DDT, Polychlorinated biphenyls.

To investigate the effects of thousands of tons of domestic and industrial wastes dumped off the coast of Los Angeles, the impairment in white croaker (Csiaenidae: Genyonemus lineatus) was studied. White croaker were collected from San Pedro Bay SPB), a contaminated site near Los Angeles, and Dana Point (DP), a reference site 80 km to the southeast. Chlorinated hydrocarbon concentrations were higher in livers and gonads of white croaker from SPB. Females from SPB produced fewer eggs per spawn and had lower fertilization rates. Fish from SPB had fewer early oocytes and a higher proportion of early oocytes undergoing atresia. Ovarian DDT concentrations

of spawnin SPB croakers were less than ovarian concentrations of fish from the general population in the bay. Ovarian PCB concentrations were not different between spawning SPB fish and fish from the general population in the bay. Although reductions in reproductive success are correlated with body burdens of total DDT, it is probably not solely responsible for the observed effects since other contaminants (polycyclic aromatic hydrocarbons and metals) occur at high concentrations in SPB sediments and fishes. (Miller-PTT)
W89-04551

ANTICHOLINESTERASE EFFECT OF THE COTTON DEFOLIANT S,S,S-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) ON CHANNEL CATFISH,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. Habig, and T. T. DiGiulio.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 193-197. 2 fig, 15 ref. National Toxicology Training Program Grant 92ES 07031.

Descriptors: *Defoliants, *Water pollution effects, *Phosphothioates, *Toxicity, Path of pollutants, *Cotton, *Fish, *Catfish, *Defoilants, Channels, Cytochromes.

The anticholinesterase activity of the organophosphorus cotton defoliant S,S,S-tri-n-butyl phosphorotrithioate (DEF) towards channel catfish was investigated using in vivo and in vitro techniques. Acetylcholinesterase activity and tissue concentrations of DEF were determined following 96 h exposure of catfish to sublethal dose of DEF using aerated, static aquaria. The results indicated a progressive decrease in brain and muscle acetylcholinesterase activity during the exposure, but the maximum anticholinesterase effect occurred several days following transfer to DEF-free aquaria. However, maximum tissue concentrations of DEF typically occurred at 48 h of exposure, suggesting that DEF undergoes metabolic activation. In vitro incubations of DEF with catfish brain acetylcholinesterase. Inclusion of a microsomal activation system in the incubation mixture indicated that DEF is converted into a potent anticholinesterase agent by rat liver and catfish liver microsomes. Activation is dependent on oxygen and is primarily mediated by cytochrome P-450. (Author's abstract)
W89-04552

INFLUENCE OF CADMIUM EXPOSURE ON PLASMA CALCIUM, VITELLOGENIN AND CALCITONIN IN VITELLOGENIC RAINBOW TROUT,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
C. Haux, B. T. Bjornsson, L. Forlin, A. Larsson, and L. J. Deftos.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 199-202. 1 fig, 1 tab, 8 ref.

Descriptors: *Water pollution effects, *Cadmium, *Fish, *Trout, *Toxicity, Heavy metals, Vitellogenin, Calcitonin, Path of pollutants, Metabolism, Electrolytes.

Effects of cadmium exposure on plasma levels of calcitonin and free and protein-bound calcium were studied in vitellogenic female rainbow trout kept in brackish water (7 ppt). Fish were exposed to 100 microg cadmium/L for four weeks. Exposure of female rainbow trout in the stage of vitellogenesis, with increased total plasma levels of calcium, resulted in a complex hypocalcemic response. Thus, hypocalcemia was found to be due to three different processes: (1) a decrease in the free plasma calcium, and a reduction in protein-bound calcium, (2) decreased plasma levels of vitellogenin, and (3) a reduced binding of calcium to vitellogenin. These findings support the concept of an interference of cadmium with ion-regulating tissues as a mechanism for hypocalcemia in rainbow trout. A direct effect on the vitellogenin-binding of calcium was also observed and reproductive function in the females was affected by decreased plasma levels of vitellogenin. In spite of the marked changes of plasma calcium in exposed fish, no significant effects on plasma calcitonin were observed, indicating a lack of a direct relationship between plasma calcium and calcitonin levels in rainbow trout. (Author's abstract)
W89-04553

MULTIVARIATE APPROACH FOR EVALUATING RESPONSES OF FISH TO CHRONIC POLLUTANT STRESS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. M. Adams, J. J. Beauchamp, and C. A. Burtis.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 223-226. 2 fig, 8 ref. Department of Energy contract DE-AC05-840R21400.

Descriptors: *Multivariate analysis, *Toxicity, *Water pollution, *Water pollution effects, *Fish, *Stress, Contamination, Lipids, Metabolism.

A suite of biochemical variables and condition indices were measured simultaneously from the same organism to determine the integrated (multivariate) response of fish to stress. Aspects of electrolyte hemeostasis (serum sodium and potassium), carbohydrate metabolism (serum glucose), lipid metabolism (serum triglycerides and cholesterol), and protein metabolism (total serum protein and SGOT) were examined as biochemical indicators. The condition indices measured were total body lipids, the condition factor, liver-somatic index, and the visceral-somatic index. A canonical discriminant analysis procedure was used to compare and evaluate the multivariate response of fish collected from polluted streams to those fish sampled from control sites. Using variable selection techniques, a subset of the original suite of response variables was chosen to represent the best combination of variables reflecting integrated organism response to pollutants. The results demonstrate that the interpretation of fish response to chronic stress can differ depending on whether individual or multiple response variables are considered. (Author's abstract)
W89-04554

BIOCHEMICAL AND PHYSIOLOGICAL DISTURBANCES IN FISH INHABITING COASTAL WATERS POLLUTED WITH BLEACHED KRAFT MILL EFFLUENTS,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
T. Andersson, L. Folin, J. Hardig, and A. Larsson.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 233-236. 2 fig, 5 ref.

Descriptors: *Biochemistry, *Fish physiology, *Bleaching wastes, *Water pollution, *Water pollution effects, *Coastal waters, Path of pollutants, Effluents, Fish, Perch, Pulp wastes, Kraft mills, Tissue analysis.

Physiological and biochemical changes in perch (Perca fluviatilis) inhabiting coastal waters polluted by bleached kraft mill effluents were examined. The results show profound effects of bleached kraft mill effluents on several fundamental biochemical and physiological functions on four different sampling occasions. Typical symptoms in perch from the polluted areas were reduced gonad growth, enlarged liver and very strong induction of certain cytochrome P-450-dependent activities. Elevated content of ascorbic acid in liver tissue and strongly affected carbohydrate metabolism show that the effluent causes metabolic disorders. Marked effects on the white blood cell pattern indicate suppressed immune defence. Alterations in the red blood cell status and the ion balance suggest an impaired gill function. This extensive symptom picture is strengthened by the relatively good agreement with the effects previously observed in fish exposed to bleached kraft mill effluents in the laboratory. (Author's abstract)
W89-04555

EFFECTS OF POLYNUCLEAR AROMATIC HYDROCARBONS ON FISHES AND SHELLFISH: AN OVERVIEW OF RESEARCH IN VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
M. E. Bender, W. J. Hargis, R. J. Huggett, and M. H. Roberts.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 237-241. 1 fig, 1 tab, 5 ref.

Descriptors: *Estuaries, *Water pollution effects, *Hydrocarbons, *Bioaccumulation, *Fish, *Shellfish, *Virginia, Sediment, Oysters, Clams, Aromatic compounds, Bioassay, Environmental gradient, Lipids, Biological magnification, Sediments, Fate of pollutants, Path of pollutants.

The following topics related to polynuclear aromatic hydrocarbon pollution in estuaries are discussed: (1) the use of oysters (Crassostrea virginica), hard clams (Mercenaria mercenaria) and brackish water clams (Rangia cuneata) in residue monitoring, (2) the effects of elevated polynuclear aromatic hydrocarbon residues in oyster conditions, (3) three years of field studies relating polynuclear aromatic hydrocarbon sediment contamination to abnormalities in fishes, and (4) laboratory bioassays for effects and bioconcentration modelling. Oysters, hard clams and Rangia have been shown, from three years of field studies, to be good monitors of pollution inputs as one proceeds along salinity gradients from 25 ppt to 0.5 ppt. Effects of increased body burdens of polynuclear aromatic hydrocarbons are shown by a lowering of the oysters condition index, as measured by lipid levels. Fishes inhabiting the Elizabeth River, VA which is highly contaminated with polynuclear aromatic hydrocarbons, have higher incidence in regions of the river where the sediments are more heavily contaminated. Laboratory studies using contaminated sediments have reproduced some of the abnormalities observed in the field. Bioconcentration of polynuclear aromatic hydrocarbons from sediments has been studied with oysters and hard clams. Oysters generally accumulate three times the body burdens of clams exposed to the same suspensions. A faster depuration rate for clams appears to be responsible for the higher equilibrium body burden of oysters. (Author's abstract)
W89-04556

EFFECTS OF CERTAIN CONTAMINANTS ON EYES OF SEVERAL ESTUARINE FISHES,
Virginia Inst. of Marine Science, Gloucester Point.
W. J. Hargis, and D. E. Zwerner.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 265-270. 1 fig, 1 tab, 10 ref.

Descriptors: *Estuaries, *Fish diseases, *Eyes, *Water pollution effects, Fate of pollutants, Path of pollutants, Contamination, Hydrocarbons, Fish, Estuarine fisheries, Chesapeake Bay, Biota, Indicators, Histology.

Over 70,000 individuals of eight marine/estuarine or strictly estuarine fishes were collected from the heavily polluted Elizabeth River, a subestuary of the James River estuary (lower Chesapeake Bay). Five of the eight species were found with lens cataracts. Fin rot and skin ulcerations were also noted. Three sciaenids were among those affected by cataracts. Prevalences of all lesions were greater where polynuclear aromatic hydrocarbon contamination of the sediments was highest. Fish of the same species from the nearby reference, Nansemond River, were essentially negative. Histological examination confirmed many of the grossly detected lens cataracts. Other ocular anomalies occurred in the lenses, vitreous and aqueous chambers, choroid space, blood vessels and rete, and retinas. Since lens cataracts (and other external conditions such as fin rot, ulcerations and tumors, hyperaemia of skin, orbits and eyeballs, and abnormal color and shape) are readily detectable in the field, they should be useful pollution indicators for surveys, monitoring and management. (Author's abstract)
W89-04557

HISTOCHEMISTRY AS A TOOL FOR EXAMINING POSSIBLE PATHOLOGIC CAUSE-AND-EFFECT RELATIONSHIPS BETWEEN HEAVY METAL AND INFLAMMATORY LESIONS IN OYSTERS, CRASSOSTREA VIRGINICA,

National Marine Fisheries Service, Oxford, MD. Oxford Lab.
C. A. Farley.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 271-275. 1 fig, 1 tab, 14 ref.

Descriptors: *Histology, *Water pollution effects, Fate of pollutants, *Heavy metals, *Oysters, *Pathology, Seasonal variation, Shellfish, Microscopic analysis, Tissue analysis, New Jersen, Kidneys, Copper.

Unexplained inflammatory lesions have been shown on many occasions in oysters (Crassostrea virginica) that have been examined by histopathologic methods. Application of the Mallory's hematin and the rubeanic acid methods for demonstration of copper in histologic sections revealed strong staining reactions in granules of some, but not all, granular hemocytes. These cells were clearly involved as constituents of acute inflammatory lesions characterized by infiltration of arteries, occlusion of veins, and diapedesis through external epithelia of the mantle and gastrointestinal tract. Heavily contaminated sites (such as Raritan Bay, New Jersey) showed strong staining reactions in a large number of animals examined. Control sites (such as Great Bay, New Jersey) showed much lighter reactions. Seasonal sampling in the New Jersey sites revealed the most intensive involvement in the late summer with apparent decreasing staining intensities in the fall. Other species of bivalve mollusks (Mytilus edulis and Mercenaria mercenaria) only showed significant staining reactions for heavy metal in kidney tissues with no evidence that heavily contaminated sites had higher levels. These results constitute preliminary evidence of a cause-and-effect relationship between a heavy metal contaminant (most probably copper) and inflammatory lesions in the oyster. (Author's abstract)
W89-04558

POLLUTION-RELATED HISTOPATHOLOGICAL CHANGES IN THE MUSSEL MYTILUS EDULIS L. IN THE BALTIC SEA,

Helsinki Univ. (Finland). Dept. of Zoology.
I. Sunila.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 277-280. 9 ref.

Descriptors: *Histology, *Water pollution effects, Fate of pollutants, *Baltic Sea, *Mussels, *Pathology, Shellfish, Finland, Heavy metals, Tissue analysis.

Pollution-related, histopathological changes in mussels sampled from the Baltic Sea are described. Field samples were collected from 23 polluted and unpolluted sites from the coasts of Finland (salinity 4.5-7 ppt). Histopathological observations are surveyed against previous laboratory studies, where mussels were exposed in aquaria to copper and cadmium in brackish water. Changes, which were induced in aquaria and occurred also at polluted sites, were phagocytosis of sperm in the follicles and gill lesions (hyperplasia of epithelia, metaplastic interfilamentary junctions and a chronic inflammatory reaction). In addition, occurrence of inflammatory reactions, ulcers and hemorrhages of the digestive tract and kidney lesions correlated with polluted sites. (Author's abstract)
W89-04559

PRELIMINARY INVESTIGATIONS OF THE CHEMILUMINESCENT RESPONSE IN NORMAL AND POLLUTANT-EXPOSED FISH,

Virginia Inst. of Marine Science, Gloucester Point.
J. E. Warinner, E. S. Mathews, and B. A. Weeks.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 281-284. 1 fig, 1 tab, 9 ref. Marine Biochemical Center, Duke University Marine Laboratory Feasibility Study grant ESO 1908.

Descriptors: *Water pollution effects, *Assays, *Fish, *Macrophages, *Luminescence, Population exposure, Fate of pollutants, Path of pollutants, Kidneys, York River, Staphylococcus, Elizabeth River, Hydrocarbons.

A luminol-dependent chemiluminescence assay was developed and tested with macrophages isolated from the kidneys of spot (Leiostomus xanthurus) and hogchoker (Trinectes maculatus). Both peak amplitude and time of maximum response have been observed to vary with the species tested and the stimulus used. In York River (reference), spot zymosan elicited the most immediate response with a peak at 18 min, while the response induced by Staphylococcus aureus was delayed (28 min). In York River (reference) hogchoker, the most immediate response was induced by phorbol myristate acetate with a peak at 7 min. S. aureus and zymosan elicited somewhat delayed responses (13 min and 15 min, respectively). Macrophages from spot captures in the Elizabeth River, which is highly contaminated with polynuclear aromatic hydrocarbons, were markedly deficient in generating a zymosan-induced chemiluminescence response compared with York River reference fish. Spot exposed in the laboratory to contaminated sediments showed a similar decrease in the chemiluminescence response. These preliminary findings reveal interspecies differences in the chemiluminescence response of selected species of finfish, as well as variations within species in the chemiluminescence response to different stimuli. More importantly, the results demonstrate distinct suppression of the chemiluminescence response in fish exposed either in vivo or in vitro to polynuclear aromatic hydrocarbon contaminated river sediments. (Miller-PTT)
W89-04560

EFFECTS OF PARAQUAT ON MICROSOMAL OXYGEN REDUCTION AND ANTIOXIDANT DEFENSES IN RIBBED MUSSELS (GEUKENSIA DEMISSA) AND WEDGE CLAMS (RANGIA CUNEATA),

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
R. J. Wenning, and R. T. DiGiulio.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 301-305. 2 tab, 11 ref.

Descriptors: *Biochemical tests, *Water pollution effects, Fate of pollutants, Path of pollutants, *Mussels, *Clams, *Paraquat, Shellfish, Herbicides, Catalysts, Pigments, Enzymes, Lipids.

The hepatopancreae of the ribbed mussel, Geukensia demissa, and the wedge clam, Rangia cuneata, were examined for their ability to catalyze the reduction/oxidation cycling of the bipyridal herbicide paraquat. In vitro studies indicated a dose-dependent increase in the rate of superoxide anion, O2(-), generation in microsomal fractions supplemented with NADPH. The highest concentration of paraquat employed (4 milliM) elicited an 81% increase in cytochrome reduction in G. demissa nd 135% increase in R. cuneata. In both species, cytochrome reduction was inhibited by the addition of exogenous superoxide dismutase. For in vivo studies, a single application of paraquat (0.5, 1.0, or 2.0 milliM) was added to aerated salt-water aquaria containing G. demissa. Biochemical analyses of antioxidant enzymes, reduced glutathione and lipid peroxidation were performed in hepatopancreatic tissue after exposures of 6, 12, 24 and 36 h. Results support the hypotheses that these bivalves can activate redox cycling compounds and demonstrate in vivo responses typical of oxidative stress as observed in other organisms. (Author's abstract)
W89-04561

COMPARATIVE HISTOPATHOLOGICAL EFFECTS OF CHEMICALLY CONTAMINATED SEDIMENT ON MARINE ORGANISMS,

Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
G. R. Gardner, and P. P. Yevich.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 311-316. 2 tab, 8 ref.

Descriptors: *Water pollution effects, *Toxicity, *Carcinogens, Fate of pollutants, *Contamination, *Sediment, *Fish, *Invertebrates, Comparison studies, Connecticut, Path of pollutants, Long Island sound, Oysters, Lobsters, Mussels, Flounder.

Comparative pathological effects in three species of fish and six species of invertebrates were investigated using a chemically contaminated sediment from Black Rock Harbor, Connecticut. Substances contained in Black Rock Harbor sediment are known to be genotoxic, carcinogenic, co-carcinogenic and tumor-promoting. Proliferate lesions were observed in winter flounder (Pseudopleuronecteds americanus) external, oral, and esophageal epithelial surfaces, renal vascular and nephroblastic elements, and the pancreatic islets. Islet lesions included cystic adenomas and a diffuse islet proliferative condition, nesidioblastosis. In addition, pathology was enhanced when winter flounder were fed mussels (Mytilus edulis) previously exposed to Black Rock Harbor sediment. Neoplastic lesions developed in kidney tubule epithelia, gills, some regions of the gastrointestinal tract, neural elements and heart of oysters (Crassostrea virginica) exposed to Black Rock Harbor sediment for 30 days in the laboratory. In addition, renal carcinomas in three oysters had metastasized to the visceral ganglion. Lesions were also found in oysters exposed in situ in Black Rock Harbor and Long Island Sound for 30 or 36 days. Digestive diverticula, gills and kidneys appeared to be the prime organs affected in mussels, soft-shelled clams (Mya arenaria) and oysters exposed to Black Rock Harbor sediment. Mucous cell activity increased greatly in corals (Astrangia densa) while no microscopic lesions were detectable in lobster (Homarus americanus) exposed in the laboratory. Myxomas were also found in the hearts of <5% of the mussels exposed in the laboratory. (Author's abstract)
W89-04562

DEVELOPMENT OF IN VIVO GENOTOXICITY TESTS IN ESTUARINE FISH AND THEIR APPLICATION TO AQUATIC TOXICOLOGY,

Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5A.
W89-04563

INVESTIGATION OF EFFECTS OF ENVIRONMENTAL XENOBIOTICS TO FISH AT SUBLETHAL LEVELS BY MOLECULAR BIOLOGICAL APPROACHES,

Center of Marine Biotechnology, Baltimore, MD.
T. T. Chen.
Marine Environmental Research MERSDW, Vol. 24, No. 1-4, 1988, p 333-337. 2 fig, 5 ref. NSF grant DCB 851069.

Descriptors: *Molecular biology, *Water pollution effects, Fate of pollutants, *Fish, *Hydrocarbons, *Sublethal effects, *Toxicity, Trout, Bioassay, DNA, Aromatic compounds, Fish physiology.

Studies are described on the development of biological parameters for the following: (1) the investigation of toxic mechanisms of environmental xenobiotics at sublethal levels, and (2) the screening of any other toxic chemical pollutants in the aquatic ecosystems. Through molecular cloning, cDNA of estrogen-responsive genes and growth hormone gene of rainbow trout have been isolated. In appropriate rainbow trout primary or established cell culture systems, these cDNA clones can be used as molecular probes for the elucidation of molecular toxic mechanisms of environmental xenobiotics. These findings offer the possibility of developing an in vitro system for the investigation of toxic mechanisms of polyhalogenated and polynuclear aromatic hydrocarbons at the molecular level. This in vitro system can be also be applied to screen chemical pollutants that may disrupt the reproductive physiology of fish. The proposed system has several unique features: (1) it allows the detection of adverse effects of pollutants at the transcriptional and translational levels, (2) a shorter exposure time is required, (3) every cell received homogeneous levels of the test chemicals or hormone, and (4) compared to any in vitro system, much lower levels of the test chemicals are required. (Miller-PTT)
W89-04564

5D. Waste Treatment Processes

IMPROVED MICROBIAL, VOLATILE SOLIDS, AND COD REDUCTIONS IN AN AUTOHEATED AEROBIC DIGESTER,
Cornell Univ., Ithaca, NY.
J. H. Martin, H. E. Bostian, and A. D. Venosa.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-185632. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/053, March 1988. 22p, 3 fig, 7 tab, 14 ref. EPA Contract CR 811776.

Descriptors: *Wastewater treatment, *Microbiological studies, *Chemical oxygen demand, *Aerobic treatment, *Cold regions, Suspended solids, Digestion, Coliforms, Bacteria, Temperature.

Modifications were made to an aerobic digester permitting the digester to comply with PSRP requirements in cold climates. The modifications included addition of an insulated cover to prevent escape of the heat of oxidation to the atmosphere and installation of better aeration equipment to improve oxygen mass transfer from the air. From the results of this study, it appears that use of aerobic digestion as a process to significantly reduce pathogens, assuming two log reductions in the densities of coliform organisms and a 38% reduction in total volatile solids concentration as requirements, is technically feasible at ambient air temperatures at or below freezing. With respect to fecal streptococci, which were observed to be more resistant to the adverse conditions of aerobic digestion than the other indicators, a trend toward increased reductions was occurring with longer residence times. It appears that residence times longer than 20 days are likely needed to achieve a 2-log reduction in these indicators, even at the elevated mixed liquor temperatures of an autoheated digester. (Lantz-PTT)
W89-03342

DESIGN OF INNOVATIVE FLOTATION-FILTRATION WASTEWATER TREATMENT SYSTEMS FOR A NICKEL-CHROMIUM PLATING PLANT,
Lenox Inst. for Research, Inc., MA.
L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-200522. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. LIR/01-84/65, January 1984. 36p, 8 fig, 12 ref. Lenox Project J8401-9-R83P04.

Descriptors: *Wastewater treatment, *Flotation, *Filtration, *Metal-finishing waste, *Nickel, *Chromium, Chemical precipitation, Heavy metals, Industrial wastewater.

Due to the wastes generated by the nickel-chromium plating process and the local, state and federal environmental laws appertaining, it is important and necessary that effluents from the process be pretreated prior to discharge into a city sewer system. This new pretreatment in Sanford, North Carolina is to be accomplished by the relocation and installation of an existing conventional wastewater treatment system which is presently in use at the New Britain Tool Division in Covington, Tennessee. This report describes the chemical and physical methods incorporated in the pretreatament system, the modifications made to improve the wastewater treatment system, and the methods and modifications to the operation of the system. Special emphasis is placed on the presentation of: (a) detailed chemistry of nickel-chromium plating wastewater treatment; (b) conventional reduction-precipitation treatment system; (c) modified reduction-flotation treatment system; and (d) innovative flotation-filtration treatment systems. (Lantz-PTT)
W89-03349

POLLUTANT ADSORBENT SYSTEMS FOR TNT, RDX, AND HMX IN WASTEWATER,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
R. K. Kulkarni.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A188 407. Price codes: A03 in paper copy, A01 in microfiche. Technical Report 8605, October 1986. 14p, 5 tab, 11 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Trinitrotoluene, *Hazardous wastes, *Toxic wastes, *Explosives, *Trinitrotetrazocine, *Trinitrotriazine, Silica, Polymers, TNT, RDX, HMX.

Silica gels were prepared in the presence and absence of the pollutants TNT (2,4,6-trinitrotoluene) RDX (1,3,5-trinitrotoluene) and HMX (1,3,5,7-tetronitro-1,3,5,7-tetrazocine or 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane), and purified by exhaustive elution with methanol and acetonitrile. Gels prepared in the presence of TNT or RDX consistently showed enhanced adsorptive power for the homologous pollutant. The same was not true with HMX because of its very limited solubility. These gels, when their hydroxyl groups were capped with trimethylchlorosilane, exhibited the same higher adsorptive power. The relative adsorptive power (selective/control) was < 2. Thus, the adsorption was still too small for practical use in detection or removal of these pollutants from wastewater. Cross-linked acrylic polymers were similarly prepared in the presence of TNT, RDX, and HMX. These new polymers did not show any trend of increased adsorption in the case of TNT and RDX, perhaps because of high chain-transfer and inhibitive properties of TNT and RDX in the free radical polymerization. However, HMX-modified cross-linked polyacrylates did not show a reasonable increase in adsorptivity over the normal control cross-linked polymer. (Author's abstract)
W89-03350

METAL VALUE RECOVERY FROM METAL HYDROXIDE SLUDGES: REMOVAL OF IRON AND RECOVERY OF CHROMIUM,
Montana Coll. of Mineral Science and Technology, Butte. Dept. of Metallurgical and Mineral Processing Engineering.
L. G. Twidwell, and D. R. Dahnke.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-176078. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/019, March 1988. 202p, 54 fig, 43 tab, 41 ref, 18 append. EPA Contract CR-812533-01.

Descriptors: *Waste recovery, *Metals, *Sludge, *Iron, *Chromium, *Metal-finishing wastes, Chemical precipitation, Chemical treatment, Phosphates, Zinc, Nickel, Cadmium, Economic aspects, Costs, Water pollution control.

The objectives of this investigation were to develop flowsheets to separate and recover metal values from electroplating sludge materials; to collect bench scale experimental data to verify the feasibility of the proposed flowsheets; to demonstrate the effectiveness of the separability on a large scale (75-100 pounds of sludge/day); and to develop a first order economic evaluation of the proposed flowsheets for a centralized treatment facility. The emphasis of the project was directed toward investigating the application of phosphate precipitation as a means of selectively separating iron and chromium from divalent cation species. These objectives have been accomplished. Flowsheets and alternatives are discussed in the body of this report. The feasibility of the developed flowsheets has been verified by laboratory test work. Selective metal value separations have been shown to be possible, e.g., iron and chromium can be separated from divalent metals such as zinc, nickel, and cadmium. Large scale test work has verified that effective separations are feasible and practical. A first order economic evaluation has been performed and shows that an excellent return on investment is possible, e.g., 60 plus or minus 18% based on recovered metal and metal salt values and 106 plus or minus 32% if a credit is taken for disposal cost. (Author's abstract)
W89-03361

INTERACTIVE SIMULATION OF THE FATE OF HAZARDOUS CHEMICALS DURING LAND TREATMENT OF OILY WASTES: RITZ USER'S GUIDE.
Robert S. Kerr Environmental Research Lab., Ada, OK.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-195540. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/8-88/001, January 1988. 61p, 21 fig, 8 tab, 10 ref, append. EPA Contract CR-812808.

Descriptors: *Computer programs, *Oil waste, *Waste treatment, *Land treatment, *Fate of pollutants, *Simulation analysis, *Mathematical models, *Chemical wastes, *Hazardous wastes, Land disposal, Path of pollutants, Model studies, Sludge, Volatilization, Degradation, Computers.

An interactive software system was developed to enable decision makers to simulate the movement and fate of hazardous chemicals during land treatment of oily wastes. The mathematical model known as the Regulatory and Investigative Treatment Zone model or RITZ, was developed and published earlier. The model incorporates the influence of oil in the sludge, water movement, volatilization, and degradation upon the transport and fate of a hazardous chemical. This manual describes the conceptual framework and assumptions used in developing the model. It then explains the micro-computer hardware and software requirements, the input parameters for the model, and the graphical and tabular outputs which can be selected. Illustrations of the use of the software are also included. (Author's abstract)
W89-03362

OVERVIEW OF ALTERNATIVE SEWER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 8A.
W89-03365

PRELIMINARY DESIGN REPORT OF A 10-MGD DEEP SHAFT-FLOTATION PLANT FOR THE CITY OF BANGOR, MAINE, USA.
Krofta Engineering Corp., Lenox, MA.
L. K. Wang, and P. G. Daly.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-200597. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. KEC/07-87/265, July 6, 1987. 41p, 5 fig, 7 tab.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Bangor, *Maine, *Flotation, Design standards, Biological treatment, Municipal wastewater.

Descriptions of two proposed deep shaft-flotation wastewater treatment systems (Deep Shaft-Supracell System and Deep Shaft-Sandfloat System) for an anticipated expansion to secondary treatment at the city of Bangor, Maine are contained in this report. The first proposed 10-MGD design includes two deep shaft bioreactors, each 96 inches in diameter, placed to a depth of 300 ft. The deep shaft reactor effluent flows to a 7290-gpm Supracell flotation clarifier, 55 ft in diameter and 87 inches in total depth. The second proposed 10-MGD design also includes two deep shaft bioreactors (96 inches diameter and 300 ft in depth). The deep shaft reactor effluent, however, flows to a 10-MGD Sandfloat clarifier 55 ft in diameter and 87 inches in total depth. Air is supplied by compressors rated at 100 psig. Each complete Deep Shaft-Flotation system can be accomodated in 3,200 sq ft of space. (Lantz-PTT)
W89-03366

ANAEROBIC TREATMENT OF PULP AND PAPER MILL EFFLUENT,
National Timber Research Inst., Pretoria (South Africa).
J. S. M. Venter.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-206727. Price codes: E05 in paper copy, E05 in microfiche. Report No. CSIRO/HOUT-63, February 1987. 21p, 24 ref.

Descriptors: *Pulp wastes, *Anaerobic digestion, *Wastewater treatment, *Pulp and paper industry, Process control, Chemical oxygen demand.

The principles of anaerobic treatment of pulp and paper mill effluent are discussed with special reference to advantages, disadvantages, different approaches, hardware, and process control. Although the process is used mainly in the food processing industry, its use in the pulp and paper industry is gaining ground. A prerequisite for its use is that the effluent stream should have a high concentration of not less than 2500 mg/L COD (chemical oxygen demand). Loading rates of up to 20 kg COD/cu m/day have been achieved. The use of an anaerobic fermentation process followed by aerobic treatment can yield COD removals of better than 98%. (Author's abstract)
W89-03367

EFFLUENT DEWATERING RESEARCH FOR MSW AND WASTEWATER TREATMENT SLUDGES,
Argonne National Lab., IL.
C. V. Pearson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-005991. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-871269--2, (1987). 12p, 5 fig, 20 ref. DOE Contract W-31-109-ENG-38.

Descriptors: *Sludge disposal, *Wastewater treatment, *Sludge drying, Temperature, Solids, Energy, Odor control, Incineration.

Since 1983 the program for investigation of methods to achieve near energy independence in wastewater treatment plants has focused on two areas that have the greatest possibility for energy reduction and subsequent energy production in the processing of municipal wastewater. Development of a low energy process to produce combustor-fuel-quality sludge has been the primary focus of the program. Two processes have been investigated: the Batelle Memorial Institute electro-acoustic process, and low-grade energy, contact-drier process being developed at Clemson University. Both processes have achieved solids concentrations of from 37 to 45% using no more energy than is required by conventional equipment to achieve 15 to 22% solids. The end-product is autogenous and appears to be capable of being burned for energy production as a single fuel and is able to achieve the desired 1500 to 1700 F flame temperature required for odor control. (Author's abstract)
W89-03378

RECENT ADVANCES IN ODOR POLLUTION ABATEMENT: A COMPUTER SEARCH,
Lenox Inst. for Research, Inc., MA.
L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168059. Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. LIR/04-85/136, April 30, 1985. 54p.

Descriptors: *Massachusetts, *Odor control, *Wastewater treatment, *Literature review, Oxidation, Adsorption, Ion exchange, Municipal wastewater, Industrial wastewater, Odor, Springfield.

The Springfield Regional Wastewater Treatment Plant (SRWTP) on Bondis Island, Massachusetts has been a source of obnoxious odors since 1975. The odor problem is extremely serious in the Summer, particularly in Springfield's South End, across the Connecticut River from the Agawam location. In April 1985, the City of Springfield, Massachusetts retained a private firm to conduct an engineering study for systematical exploration of a solution to alleviate the odor problem before it became a more serious citizen's concern. In this report, the computer literature stored in the ENVIROLINE Database on various deodorization technologies (such as modification, oxidation, adsorption, wet scrubbing, ion exchange, etc.) currently being used in municipal and industrial wastewater treatment plants were searched and documented in Chapter II for reference by the City of Springfield. (Lantz-PTT)
W89-03380

TERTIARY WASTEWATER TREATMENT,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168133. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. LIR/01-86/169, January 15, 1986. 23p, 4 fig, 2 tab, 2 ref.

Descriptors: *Tertiary wastewater treatment, *Wastewater treatment, Suspended solids, Filtration, Flotation, Sandfloat, Bacteria, Biological oxygen demand, Chemical oxygen demand.

Tertiary filtration is an advanced wastewater treatment process generally used for the removal of suspended solids from secondary effluent. This technical report introduces the process principles, technology status, applications, limitations, performance, chemical treatment, waste residuals, design criteria, reliability, and environmental impact of tertiary filtration. Special introduction is given to a newly developed Sandfloat process which is the combination of secondary flotation and tertiary filtration. The waste treatment efficiencies of both conventional tertiary filters and innovative Sandfloats are presented. Mechanical reliability of both conventional tertiary filter and innovative Sandfloat can be considered high, provided suitable preventive maintenance and inspection procedures are observed. Plugging of biological sludge in filter media may be a problem when periodical chlorination of filter media is ignored. While excessive biological growth on the filter media will reduce the filter run time and increase the hydraulic head loss across the filter media, non-excessive biological growth on the filter media will improve the filtration performance on BOD and COD removals. The filter media with non-excessive biological or bacterial growth on the media surface will act like trickling filter media for final polishing of wastewater if sufficient dissolved oxygen is provided. Since Sandfloat has a built-in dissolved air flotation, the wastewater being treated by Sandfloat is sufficiently aerated for maximizing the biological treatment function. Accordingly the treatment performance of Sandfloat in terms of BOD and COD removals will be much higher than that of conventional tertiary filter. Soluble phosphate can be almost totally removed by Sandfloat but cannot be removed by conventional tertiary filter without clarification as pretreatment. (Lantz-PTT)
W89-03381

ALTERNATIVE COOLING WATER SYSTEMS, SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.
Department of Energy, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003321. Price codes: A99 in paper copy, A01 in microfiche. Report No. DOE/EIS--0121, October 1987. Final Environmental Impact Statement. 736p, 27 fig, 59 tab, 183 ref, 10 append.

Descriptors: *Water pollution sources, *Thermal pollution, *Nuclear power plants, *Water pollution prevention, *Cooling water, *Savannah River Plant, *Environmental Impact Statement, Aiken, South Carolina.

This Environmental Impact Statement (EIS) provides environmental input into the selection and implementation of cooling water systems for thermal discharges from the K-Reactor and C-Reactor and from a coal-fired powerhouse at the Savannah River Plant. The Savannah River Plant is a major U.S. Department of Energy installation for the production of nuclear materials for national defense. This EIS addresses the potential environmental consequences of constructing and operating once-through and recirculating cooling towers for the K-Reactor and C-Reactor; increased pumping to a raw water basin and direct discharge to the Savannah River for a coal-fired powerhouse; and no action. The potential environmental consequences assessed include effects on air and water quality, ecological systems, archaeological resources, endangered species, and wetlands. (Author's abstract)
W89-03387

GLOBAL VIEW OF RESOURCE RECOVERY,
International Bank for Reconstruction and Development, Washington, DC. Infrastructure and Urban Development Dept.
S. Arlosoroff.
Biocycle BCYCDK, Vol. 29, No. 9, p 52-55, October 1988.

Descriptors: *Water reuse, *Regional development, United Nations, Composting, Appropriate technology, Public health, Wastewater renovation.

The World Bank and the United Nations Development Program (UNDP) Water and Sanitation Program was launched to assist countries in providing poor people with water and sanitation services based on appropriate technology and community involvement. Encouraged by the success of composting plants, the Bank is supporting a lending project in Egypt involving a number of composting plants in Alexandria and Giza. Research on public health and environmental issues of wastewater reuse has led to development of operational guidelines and identification of adequate technologies for treatment and reuse. One important component of the Bank/UNDP Program is analyzing regional experience and exchanging information on problems and potential solutions in European and Mediterranean countries. The remaining challenge is to demonstrate effectiveness of the systems and extend the demonstration into national programs. (Shidler-PTT)
W89-03395

RATES OF NUTRIENT UPTAKE AND GROWTH OF THE WATER HYACINTH (EICHHORNIA CRASSIPES (MART.) SOLMS),
Hiroshima Univ. (Japan). Faculty of Engineering.
T. Imaoka, and S. Teranishi.
Water Research WATRAG, Vol. 22, No. 8 p 943-951, August 1988. 14 fig, 3 tab, 19 ref.

Descriptors: *Water pollution treatment, *Wastewater treatment, *Nutrient removal, *Phosphorus removal, *Nitrogen removal, *Plant growth, *Water hyacinth, *Wastewater treatment, Nutrients, Macrophytes, Water quality, Fate of pollutants, Nitrogen, Phosphorus, Absorption.

The nutrient uptake and growth of an aquatic macrophyte, water hyacinth (Eichhornia crassipes (Mart.) Solms), were investigated in a static system and a continuous flow system of a nutrient solution. It was found that the specific growth rate was dependent on the air temperature, plant density and nitrogen (N) content. The N uptake rate was correlated with the N concentration by the Michaelis-Menten-type equation, in which the maximum uptake rate of N was expressed as a function of the temperature and plant density. While the phosphorus (P) uptake rate was influenced by not only the P concentration, temperature and plant density, but also by variations of the P content of the plant. The results of the simulation study using the proposed rate equations suggested that the efficiencies of the N and P removals from the secondary sewage effluent, by means of water hyacinth cultivation, were exceedingly influenced by the surface base retention time of the water, and did not depend on the plant density either after harvesting or the harvesting period itself under the usual culture conditions, and it was suitable that the surface base retention time of the water was 40 day/m in a temperate climate, such as Japan's, in order to obtain a high removal efficiency of 70%. (Author's abstract)
W89-03430

COMBINED MEMBRANE FILTER-IMMUNOFLUORESCENT TECHNIQUE FOR THE IN SITU IDENTIFICATION AND ENUMERATION OF ACINETOBACTER IN ACTIVATED SLUDGE,
Pretoria Univ. (South Africa). Dept. of Microbiology and Plant Pathology.

T. E. Cloete, and P. L. Steyn.
Water Research WATRAG, Vol. 22, No. 8, p 961-969, August 1988. 10 tab, 23 ref.

Descriptors: *Filtration, *Bacterial analysis, *Laboratory techniques, *Fluorescence, *Activated sludge process, *Wastewater treatment, *Nutrient removal, Activated sludge, Membrane filters, Fate of pollutants, Phosphorus removal.

Biological phosphorus removal in activated sludge has been ascribed to phosphorus uptake by Acinetobacter. However due to the lack of suitable identification and enumeration techniques, the exact role of Acinetobacter as a phosphorus removing agent was not clear. During this study a suitable fluorescent antibody (FA) technique combined with membrane filtration was developed for the identification and enumeration of Acinetobacter in activated sludge. The acridine orange (AO) staining technique was applied to enumerate the total number of bacteria in activated sludge and the total number of viable Acinetobacter numbers was determined using agar plating techniques combined with population structure studies using the API-20E identification system. The latter technique indicated that Acinetobacter was the dominant organism in activated sludge. However a comparison of the AO total count and FA Acinetobacter count indicated that Acinetobacter constituted $<10\%$ of the AO count, suggesting that the role of Acinetobacter in activated sludge was probably overestimated in the past. (See also W89-03433) (Author's abstract)
W89-03432

ROLE OF ACINETOBACTER AS A PHOSPHORUS REMOVING AGENT IN ACTIVATED SLUDGE,
Pretoria Univ. (South Africa). Dept. of Microbiology and Plant Pathology.
T. E. Cloete, and P. L. Steyn.
Water Research WATRAG, Vol. 22, No. 8, p 971-976, August 1988. 4 fig, 4 tab, 21 ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Wastewater treatment, *Bacteria, *Nutrient removal, *Activated sludge, Bacterial analysis, Electron microscopy.

Biological phosphorus removal in activated sludge is not fully understood. Acinetobacter has been implicated as the principal phosphorus removing agent. Using transmission electron microscopy the cell volume of volutin containing cells and the volutin volume were determined. This confirmed that only large Acinetobacter cells contained phosphorus. Electron dispersive micro-analysis of X-rays confirmed that the volutin contained phosphorus. Using Acinetobacter numbers, volutin volumes, densities and phosphorus content it was determined that a maximum of 34% of the observed phosphorus removal in activated sludge could be removed by Acinetobacter as polyphosphate. Other organisms or mechanisms therefore also had to be involved for the observed phosphorus removal. (See also W89-03432) (Author's abstract)
W89-03433

REMOVAL OF PCBS FROM WASTEWATER IN A SIMULATED OVERLAND FLOW TREATMENT SYSTEM,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
J. H. Pardue, R. D. DeLaune, and W. H. Patrick.
Water Research WATRAG, Vol. 22, No. 8, p 1011-1015, August 1988. 4 fig, 2 tab, 15 ref.

Descriptors: *Simulation analysis, *Land treatment, *Overland flow, *Wastewater treatment, *Polychlorinated biphenyls, Organic wastes, Land disposal, Sorption, Biodegradation, Fate of pollutants, Infiltration, Separation techniques, Model studies.

Overland flow systems have been proposed as an efficient alternative for the removal of organic pollutants from aqueous waste streams. A simulated wastewater containing polychlorinated biphenyls (PCBs) was added to a model overland flow treatment system. Movement, biodegradation and volatilization of the PCBs were determined in the system using C14-labeled PCBs and PCB congener-specific, high resolution gas chromatography. PCB removal approached 100% in this system. Movement of PCBs in the soil was minimal with removal occurring primarily in the upper sections of the slope. Mineralization of PCBs was low ($<$ or $=$ 2% of the PCBs added) over the time frame of this experiment. (Author's abstract)
W89-03438

MODELING STUDY OF THE EFFECT OF PH ON CARBON LIMITED ALGAL BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. K. Liehr, J. W. Eheart, and M. T. Suidan.
Water Research WATRAG, Vol. 22, No. 8, p 1033-1041, August 1988. 10 fig, 1 tab, 28 ref.

Descriptors: *Biofilms, *Limiting nutrients, *Algal growth, *Carbon, *Model studies, *Wastewater treatment, *Hydrogen ion concentration, Carbon dioxide, Respiration, Photosynthesis, Nutrient removal, Biomass.

There is a growing interest in using photautrotropic organisms in engineered systems because of their ability to capture light energy and covert it to useful purposes, such as biomass production for use as food or energy; in wastewater-treatment systems they are used for removal of nitrogen and phosphorus. Attached growth is often preferred to suspended growth for the mass culture of algae for these applications because large amounts of biomass can be accumulated in a relatively small area, and because the biomass can easily be separated from the liquid. A model was developed that describes concentration profiles and flux of carbon into inorganic carbon-limited algal biofilms. The model considers carbon dioxide utilization and production from photosynthesis and respiration, diffusion of the inorganic carbon species, and pH changes due to CO_2 utilization. The overall material balance gave a nonlinear ordinary differential equation coupled with an integral differential equation. This system was solved using a Runge-Kutta-Verner fifth and sixth order method. The bulk (interfacial) total carbon and pH were assumed fixed. The boundary value problem was solved with a shooting technique, where the interfacial slope was initially guessed and subsequently adjusted using the secant method. The results showed that bulk carbon concentration and bulk pH were both important aspects of inorganic carbon limitation. Parameter sensitivity was also addressed; model parameters that were found to be important to the results include diffusion coefficients, maximum utilization rate, half-saturation coefficient, and biofilm density. Results were found to be insensitive to the respiration coefficient. (Geiger-PTT)
W89-03441

OPTIMUM POND DEPTHS FOR BACTERIAL DIE-OFF,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
H. Z. Sarikaya, and A. M. Saatci.
Water Research WATRAG, Vol. 22, No. 8, p 1047-1054, August 1988. 9 fig, 2 tab, 13 ref.

Descriptors: *Coliforms, *Wastewater treatment, *Stabilization ponds, *Water depth, Performance evaluation, Cost analysis, Solar radiation, Construction costs, Optimization.

Bacterial die-off in waste-stabilization ponds is strongly affected by solar radiation. Due to the attenuation of solar radiation in the ponds, faster bacterial die-off is observed in shallow ponds. Analysis of optimum pond depths on the basis of minimum cost for the same bacterial removal efficiency were presented. The cost function depends on pond performance, defined as the ratio of coliform bacteria concentration per 100 ml at time (t) to the initial coliform concentration per 100 ml. However, except in the case of dispersed flow ponds, the pond performance has no effect on optimum pond depths. The optimum depths are the same for plug flow, and for completely mixed flow ponds. The optimum pond depth increases with a decrease in the ratio of cost of excavation to cost of land. It also increases with increasing die-off rate constant in the dark (per day), but decreases with increasing light mortality constant (sq cm/cal). (Author's abstract)
W89-03443

INVESTIGATIONS ON THE CONCENTRATION OF RADIONUCLIDES IN SEWAGE SLUDGES OF RUHRVERBAND WASTEWATER TREATMENT PLANTS 1960 THROUGH TO 1986,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-03445

COMPUTER PACKAGE HELPS CITY MANAGE SEWER SYSTEM,
Black and Veatch, Kansas City, MO.
J. P. Gray.
Public Works PUWOAH, Vol. 119, No. 11, p 52-54, October 1988. 1 fig.

Descriptors: *Utilities, *Computer programs, *Sewer systems, *Wastewater facilities, *Kansas, *Computers, Wastewater management, Data processing, Data interpretation, Wastewater treatment, Hydraulic models, Networks.

The Topeka, Kansas, Water Pollution Control Division is implementing a Sanitary Sewer Management System (SSMS) to help the city plan, operate, and manage its sanitary sewer system. The SSMS will be installed on city microcomputers for continuous and ongoing use by the city staff. The primary components of the SSMS include the following: a computerized database to include every manhole and sewer reach in the sanitary sewer systems tributary to the city's Oakland and North Topeka treatment plants; a system of screen menus for updating the databases and computer models, accessing the analysis program, and viewing or printing results; an enhanced version of Black and Veatch's BVSWR sanitary sewer analysis program, including capability for dynamic analysis of stormwater inflows; computerized hydraulic models of each of the 12 major drainage basins, along with the associated files for developing skeletonized networks and flow allocations; results of a 3-month continuous flow and rainfall monitoring program; and an interface between the complete system database and the city's sewer maintenance management program. The computer model will provide a sophisticated knowledge of the system loadings and hydraulic conditions and identify present bottlenecks and required improvements. The complete system model can be used to perform future master planning or facility planning work and to evaluate operational changes. (Geiger-PTT)
W89-03447

PREVENTIVE MAINTENANCE: TELEVISION AS A MAINTENANCE TOOL,
J. T. Kunze.
Public Works PUWOAH, Vol. 119, No. 11, p 58-60, October 1988.

Descriptors: *Inspection, *Sewer systems, *Maintenance, *Television, Monitoring, Automation.

In February of 1988, the National Council on Public Works Improvement presented its final report to the President and Congress regarding the status of America's infrastructure. The Council recommended a stronger emphasis be placed on maintenance of existing facilities. The benefits of a strong preventive maintenance program with regard to sanitary sewers are enumerated. Many communities have purchased sewer televising systems or contracted with televising service firms. Today's sewer televising systems allow inspection of both main line sewers and sewer service laterals. Sewer televising can be used for inspection of sewers prior to paving and reconstruction. Television inspection can also be used for quality control on new construction or rehabilitation/repair work. Televising of new construction provides a written record of the pipe condition and provides a

second, confirming location of any wyes, tees, or other connection. Televising programs on the order of 5 to 10% of the total system footage per year appear to be a reasonable level of internal sewer inspection. Sewer televising systems are manufactured by a number of different firms and packaged in different configurations and options. The TV systems can be packaged in a number of vehicles depending upon the purchaser's interest. Other features that can be added to either the in-line or service lateral systems include video recorders for complete recording; cataloging devices which superimpose date, time, distance and project number information; video typewriters that can be used to catalog and identify problems directly on the video tape; and computerized report production systems. (Geiger-PTT)
W89-03448

SMALL MUNICIPALITY USES CONTRACT SERVICES,
W. S. Detweiler.
Public Works PUWOAH, Vol. 119, No. 11, p 63-64, October 1988.

Descriptors: *Utilities, *Wastewater treatment, *Water treatment, *Maintenance, South Carolina, Management planning.

Two years ago, the City of Bennettsville, South Carolina was faced with a water and wastewater treatment system that was becoming difficult to manage with escalating operation and maintenance costs. City officials engaged Systems Engineering Associates Corporation (SEACOR) of New Jersey to propose a program that would upgrade the efficiency of water and wastewater services while at the same time reduce the city's budget. The company proposed to implement a strict process management system and an intensive preventive maintenance program. SEACOR was able to offer Bennettsville a nearly 20% savings over the city's original budget. An intensive program of classroom and on-the-job training in plant operation, process control, preventive maintenance, and safety was required of new employees to prepare them for the contractor's methods of conducting operations. A process management system was developed that breaks down the Bennettsville water and wastewater systems into critical process units and establishes minimum standards for all systems in operations, maintenance, and laboratory. Accountability for specific functions such as sampling, analysis, data collection, report generation, consumable supplies reordering, process control and safety procedures are assigned within each area. Standard operating procedures were developed incorporating the process management system. The status of all capital equipment was reviewed with the Bennettsville city administrator. Based on the status of equipment operability, corrective maintenance actions were prioritized into a maintenance management system. A preventive maintenance system was also implemented imposing rigid procedures and acceptance standards. Several steps have been taken to upgrade the wastewater system's capability. Two abandoned digesters were put on-line to enhance sludge drying capacity. A return sludge chlorinator was installed to reduce filamentous bulking. Plans to start an in-house laboratory are underway. Investigation into the use of alternative chemicals for water treatment is being conducted and a pretreatment program to control discharge from local industries is also being implemented. (Geiger-PTT)
W89-03450

TURNKEY TREATMENT PLANT UPGRADE,
K. R. James.
Public Works PUWOAH, Vol. 119, No. 11, p 69-71, October 1988. 1 tab.

Descriptors: *Water reuse, *Wastewater irrigation, *Wastewater treatment, *Wastewater facilities, Arizona, Cost analysis, Chlorination, Clarifiers, Biological wastewater treatment, Filtration.

In 1986, Casa Grande, Arizona decided to use effluent from its 3-mgd aerated lagoon treatment plant to irrigate the municipal golf course. The city selected Engineering Science, Inc. (ES) to prepare a study of the city's wastewater conveyance and treatment system. As part of this study, ES developed and evaluated alternatives that would upgrade the treatment process to produce effluent meeting the state's reuse standards for landscape irrigation with open access. Choosing a turnkey approach and a combined use of existing and new facilities enabled the city to obtain an upgraded wastewater treatment plant for much less than the cost of a new plant. The effluent quality from the plant would not be suitable for turf irrigation and would restrict expansion of the park and golf course. An alternative was recommended that would convert the lagoon treatment plant to a highly reliable extended aeration treatment facility. Design criteria for the upgrade targeted an effluent with a BOD5 of 2 mg/l, TSS of 2 mg/l, and 2 Ntu, which was within the state limits. The turnkey approach saved at least eight weeks in the bidding/award/mobilization process alone. As part of the project, a new 80-ft diameter suction-type clarifier was installed. Secondary effluent flows from the clarifier to a box where it is split into two streams. Secondary effluent destined for reuse at the municipal park and golf course passes over a hand-operated weir for further treatment. The second stream passes over a fixed weir, is chlorinated, and conveyed to existing plant discharge facilities. The secondary effluent stream, which is to be used for park/golf course reuse, is piped from the splitter box to a traveling bridge backwash filter. Filter effluent passes through a chlorine jet mixer at the upstream end of the chlorine contact tank. At the downstream end of the chlorine contact tank a 40-hp vertical turbine pumps the reclaimed water to the municipal park and golf course. A chemical building with a 6,000-gal liquid alum storage tank and alum feed system was also constructed. New chlorination facilities were provided as part of the contract. The city required that the major components of the upgrade be fully compatible with future expansions of the wastewater plant. (Geiger-PTT)
W89-03451

AMAZING ECONOMICS OF WASTEWATER REUSE,
J. Joerns, and W. B. Moriarty.
Public Works PUWOAH, Vol. 119, No. 11, p 78-79, October 1988.

Descriptors: *Wastewater facilities, *Land disposal, *Wastewater irrigation, *Water reuse, *Recycling, Economic aspects, Texas, Golf courses, Recreation.

The city of La Porte, Texas, in 1984, decided to irrigate its new championship golf course with secondary effluent from the wastewater treatment plant, a facility that discharged 2.2 mgd of effluent to Little Cedar Bayou for a one-mile trip to Galveston Bay. The city retained the consulting engineering firm of Espey, Huston and Associates Inc. to study, obtain permits, and design the improvements needed to convey the effluent to the municipal golf course. The proposed plan called for placing two small submersible-type pumps in the chlorine contact basin of the wastewater treatment plant, to pump the high quality effluent into the golf course lakes via a small force main. The golf course provided excellent interim storage capability, with 16 acres of lakes winding around the playing areas. Water from the lakes would then be repumped into the golf course's irrigation system. To supply enough irrigation water a system that delivers 1.2 mgd is required. To ensure a 20-minute chlorine contact time, the pumps are located in the outlet channel of the contact basin. The control system for pump operation is an automatic, level-type control system. A doppler-type flow meter was chosen to provide both total flow volume readings and 7-day recorded flows. As with all effluent irrigation systems, annual soil sampling from the root zone of the golf course is required to test for pH, total nitrogen, potassium, phosphorus, and conductivity. Payback of the entire initial investment in the irrigation system was made after only 43 days of use. (Geiger-PTT)
W89-03452

RESPONSE OF AN ALASKAN WETLAND TO NUTRIENT ENRICHMENT,
Environmental Research Lab.-Duluth, MN.
W. Sanville.
Aquatic Botany AQBODS, Vol. 30, No. 3, p 231-243, March 1988. 5 fig, 2 tab, 15 ref.

Descriptors: *Wastewater disposal, *Wetlands, *Nutrients, *Treated water, *Mosses, *Alaska, Phosphorus, Nitrogen, Phosphates, Fertilizers, Biomass, Aquatic plants, Aquatic productivity, Peat bogs, Lake sediments.

Studies were performed to determine the effects of nutrient addition to an Alaskan freshwater wetland. Nitrogen (as urea), phosphorus (as a super triple phosphate fertilizer), and secondary sewage were added to a freshwater Sphagnum wetland. Changes in the end-of-season standing biomass of the herb and shrub community were estimated. The nutrient-depth distribution in the Sphagnum was also recorded. Plots receiving the urea and phosphate fertilizer showed increased biomass when compared to controls. No changes in community structure were observed. Added nutrients appeared to be retained in the surface of the Sphagnum. No stimulatory effect of sewage was detected. This was probably the result of low application rates. (Author's abstract)
W89-03463

UTILIZATION OF TRIPLOID GRASS CARP IN SEWAGE-RETENTION PONDS FOR CONTROL OF FLOATING VEGETATION,
Florida Game and Fresh Water Fish Commission, Eustis. Fisheries Research Lab.
B. Z. Thompson, J. L. Underwood, and R. S. Hestand.
Florida Scientist FLSCA, Vol. 51, No. 2, p 115-119, Spring 1988. 1 fig, 13 ref.

Descriptors: *Carp, *Duckweed, *Aerated lagoons, *Algal control, *Weed control, Biomass, Wastewater treatment, Macrophytes, Nuisance algae, Cost analysis.

A total of 105 triploid grass carp (Ctenopharyngodon idella) were stocked, over a 3-month period, into a 0.05-ha aerated wastewater pond. The pond was initially covered with water-fern (Azolla caroliniana), but after a rise in water temperature a dominant cover of duckweed (Lemna minor) and water-meal (Wolffia spp.) was present when grass carp were stocked. Initially 26 grass carp were added to the pond; since these fish exhibited no visible vegetation control, two subsequent stockings (49 fish and 30 fish) raised the final number of fish to 105 (2,100 fish/ha) after which a decrease in vegetation biomass was observed, however, only 65 fish (1,300 fish/ha) were found to have survived. Triploid grass carp have the capability to control floating macrophytes in wastewater ponds if sufficient fish survival can be achieved. (Author's abstract)
W89-03469

DECOLORIZATION BY OZONE OF DIRECT DYES IN PRESENCE OF SOME CATALYSTS,
Kuwait Univ., Safat. Dept. of Chemical Engineering.
M. S. E. Abdo, H. Shaban, and M. S. H. Bader.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 7, p 697-710, October 1988. 7 fig, 6 ref.

Descriptors: *Dyes, *Catalysts, *Wastewater treatment, *Ozonation, Ozone, Salts, Sulfates.

Decolorization of two direct dyes (Direct Scarlet 4BS and Direct Blue 3B) by ozone in aqueous medium was studied in absence and in presence of some salts at room temperature. It was found that zinc sulfate catalyses the process of decoloration. Equations to describe the process and to allow prediction of ozone requirements were developed. The new findings of this study would have an impact on wastewater treatment techniques using ozone. (Author's abstract)
W89-03490

WATER HYACINTH PRODUCTIVITY AND DETRITUS ACCUMULATION,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 2H.
W89-03550

BIOLOGICAL WASTEWATER TREATMENT OF AZO DYES,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
G. M. Shaul, C. R. Dempsey, and K. A. Dostal.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 181-183.

Descriptors: *Dyes, *Wastewater treatment, *Activated sludge process, Anaerobic conditions, Adsorption, Biodegradation, Dye industry wastes.

The fate of azo dyes in biological wastewater treatment systems was studied to aid in the review of Premanufacture Notification submissions (as required under section 5 of the EPA's Toxic Substances Control Act) and to assist in the possible development of test rules. Results from extensive pilot-scale activated sludge process testing for 18 azo dyes and from fate studies of Disperse Blue 79 in aerobic and anaerobic wastewater treatment are presented. The possible removal mechanisms for a dye compound in the activated sludge process system include adsorption, biodegradation, chemical transformation, photodegradation, and air stripping. Recovery for most dyes was within the targeted range of 80% to 120%. It appeared that little or no chemical transformation occurred for these dyes because of contact with the variable wastewater and/or sludge matrix under these conditions. As the recoveries for all 18 dyes were generally very good with relatively low standard deviations, no corrections for recovery were made. In addition, no photodegradation of the dyes was found in laboratory studies. Moreover, the estimated Henry's law constant for each dye tested would indicate air stripping to be very unlikely. Therefore, adsorption and/or biodegradation appeared to the only removal mechanisms. (See also W89-03595) (Miller-PTT)
W89-03614

EVALUATION OF SORPTION ISOTHERMS FOR SELECTED AZO DYES AS PREDICTORS OF FATE IN AN ACTIVATED SLUDGE WASTEWATER TREATMENT PROCESS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. J. Lieberman, G. M. Shaul, C. R. Dempsey, and K. A. Dostal.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 186-187.

Descriptors: *Dye industry wastes, *Dyes, *Aerobic digestion, *Activated sludge process, *Wastewater treatment, *Sorption, Biological wastewater treatment, Activated carbon.

Since sorption is considered to be a key removal mechanism for most dyes in aerobic biological systems, laboratory batch sorption studies were evaluated for their efficacy as predictors of fate for selected azo dyes. The four sorbents used were activated sludge solids, powdered activated carbon, XAD-2 polymeric resin and XAD-7 polymeric resin. The sludge biomass was cultivated and sampled from a pilot scale activated sludge system of known operational parameters and general wastewater characteristics. The sorbates used were water-soluble azo dyes of the acid and direct categories. More than forty compounds were investigated with a little over half of them being acid dyes. In addition, all dyes were of a purified rather than commercial grade. Sorption data were applied to three widely accepted sorption models: (1) Freundlich, (2) Langmuir, and (3) Brunauer-Emmett-Teller isotherm equations. Potential relationships between the various sorbate-sorbent systems and the three sorption models were investigated. (See also W89-03595) (Miller-PTT)
W89-03616

DYES IN THE ENVIRONMENT: DYEING WASTES IN LANDFILL,
Georgia Inst. of Tech., Atlanta. School of Textile Engineering.
For primary bibliographic entry see Field 5B.
W89-03617

ELECTROCHEMICAL REMOVAL OF DYES FROM TEXTILE WASTEWATER,
Andco Environmental Processes, Inc., Amherst, NY.
K. D. Uhrich.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 191-194. 1 fig, 2 tab.

Descriptors: *Dye industry wastes, *Electrochemistry, *Textile mill wastes, *Wastewater treatment, Heavy metals, Biological oxygen demand, Chemical oxygen demand.

An electrochemical technology developed in the 1970's effectively removes many contaminants including toxic dye species and heavy metals and significantly reduces biological oxygen demand and chemical oxygen demand across many types of textile wastewater and dye species. The use of a simple electrochemical cell has been found in removing many dye species. Since this removal technique does not degrade the components, the species are removed regardless of biodegradability or toxicity. Residence time through the cell, of less than one minute, allows for relatively small treatment systems. (See also W89-03595) (Miller-PTT)
W89-03618

REDUCTION OF TOXIC WASTEWATERS IN DISPERSE AZO DYE MANUFACTURE,
CIBA-GEIGY Corp., Toms River, NJ.
A. Reife.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 197-201. 3 tab, 1 fig.

Descriptors: *Toxic wastes, *Dye industry wastes, *Wastewater treatment, *Dyes, *Toxicity, *Effluents, Disperse Blue 79 dye, Bioindicators, Disperse Blue 281 dye, Disperse Orange 30 dye, Disperse Orange 41 dye, Disperse Orange 44 dye, Disperse Red 167 dye, Water pollution control.

A major point of New Jersey's Toxicity Reduction program is the testing of mysid shrimp toxicity in plant-treated wastewater. Some of the methods that can be effectively and economically used to reduce toxic wastewater of disperse azo dye manufacture are discussed. Mysid shrimp survival can be greatly improved by reduction and/or elimination of undiazotized substituted nitroanilines and uncoupled substituted anilines by including a neutralization/heat stabilization step of coupling mass in to the procedure. Dyes and anionic surfactants found in the effluent after dispersion and standardization can be reduced and/or eliminated using the treatment technology of polymer flocculation followed by carbon adsorption. Examples of dye effluents tested are: (1) Disperse Blue 79, (2) Disperse Blue 281, (3) Disperse Orange 30, (4) Disperse Orange 41, (5) Disperse Orange 44, and (6) Disperse Red 167. (See also W89-03595) (Author's abstract)
W89-03620

RAPID, SIMPLE AND EFFECTIVE WASTE WATER TREATMENT,
I. J. Wilk, T. Themy, and T. Drury.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 363-365. 6 tab, 2 ref.

Descriptors: *Electrolysis, *Wastewater treatment, *Chlorinated hydrocarbons, Chemical oxygen demand, Biological oxygen demand, Bacteria, Ozone, Chlorination.

Tests were run at the Salt Lake City sewage treatment plant, using Brincell Model 130 units. Wastewater from a chicken processing plant was investigated for reduction in biological oxygen demand and chemical oxygen demand; solution was recirculated through the cell. Preliminary data are listed. Further tests were run to investigate the effect of the electrolysis system on chlorooorganic compounds. Carbon tetrachloride and chloroform, in the same solution, were treated. Using special electrodes, it is possible to reduce bacteria count in wastewater. Through addition of sodium chloride, the count can be brought to zero. Significant reductions on biological oxygen demand and chemical oxygen demand can be achieved. The system can degrade haloorganic compounds such as carbon tetrachloride and chloroform. It was possible to lower the CHCl3 content by 99.9% in 15 minutes. Complete elimination seems feasible. All data are preliminary in nature, with improvements likely. A possible explanation for the effectiveness of the electrolyzed solution in reducing haloorganic compounds, may be due to the fact that ozone is also formed. It has been shown that in the presence of ozone, water chlorination will result in increased water quality. (See also W89-03595) (Miller-PTT)
W89-03641

ACTIVATED CARBON ADSORPTION OF PCBS FROM HAZARDOUS LANDFILL LEACHATE,
University of Southern California, Los Angeles. Environmental Engineering Program.
For primary bibliographic entry see Field 5G.
W89-03644

PROCEEDINGS OF THE ELEVENTH UNITED STATES/JAPAN CONFERENCE ON SEWAGE TREATMENT TECHNOLOGY.
Held October 12-14, 1987 in Tokyo, Japan, Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. Report No. EPA/600/9-88/010. April 1988. 824p.

Descriptors: *Wastewater treatment, *Conferences, *Water pollution control, *Sludge, *Wastewater renovation, *Japan, Phosphorus, Conservation, Aeration.

The Eleventh United States/Japan Conference on Sewage Treatment Technology was held in Tokyo, Japan from October 12 to 14, 1987. During the Conference, papers relating to the joint research projects on sludge treatment, disposal, energy conservation, diffused aeration, phosphorus removal and wastewater reuse were presented by both sides. A Progress Report on United States/Japan Joint Research Projects (Japanese Side) was presented. Data and findings on the joint research were useful to the development of improved control technology practices for each country. A decision was made to expand the scope of the joint research projects conducted by the two countries to include disinfection. Principal topics of the Conference were current water pollution control programs in each country including innovative and alternative technology, regional approaches of toxics control, nutrients removal and application of biotechnology. (See W89-03658 thru W89-03678) (Davis-PTT)
W89-03657

CURRENT STATUS OF SEWERAGE PROJECT IN JAPAN,
Ministry of Construction, Tokyo (Japan). Dept. of Sewerage and Sewage Purification.
T. Fukui.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 7-28, 13 tab.

Descriptors: *Wastewater treatment, *Sewer systems, *Wastewater facilities, *Sludge, *Japan, Construction, Economic aspects, Budgeting.

The systematic construction of sewer systems was started under the Five-Year Program for Sewerage Construction and the Five-Year Program for Wastewater Treatment Plant Construction, both formulated in accordance with the Emergency Measures Law for Domestic Environment Institutions (1963). From 1967 on, it has been promoted under the Second to Sixth Programs for Sewerage Construction (1967). The Sixth Five-Year Program for Sewerage Construction is aimed at raising the rate of population coverage and the rate of storm sewer coverage to 46% and 44%, respectively, by the end of fiscal 1990, from 36% and 35% recorded at the end of 1985. Some of the new measures enforced recently for promotion of sewerage construction include: construction of small public sewage works, extension of subsidized range, extension of subsidized range for movable sludge treatment facilities, implementation of Water-front Verdure Landscaping Model Project, and implementation of Areas-Wide or Regional Sewage Sludge Treatment and Disposal Project (ACE Plan). The Ministry of Construction's Technical Evaluation System for Construction was established to make unbiased evaluation of the functional advantages, etc. of private sector research results relating to construction technologies. The Japan Sewage Works Agency's Technical Evaluation System passes impartial judgement on the conditions and suitability of introducing newly developed technologies relating to sewerage construction. The Evaluation System for Private Sector Techniques is the third technical evaluation system instituted to accelerate the application of newly developed private sector techniques. The Ministry of Construction and all other parties concerned are intent on redoubling their efforts to promote the construction of sewage works in Japan. (See also W89-03657) (Davis-PTT)
W89-03658

LAKE WATER QUALITY MANAGEMENT IN JAPAN,
Environment Agency, Tokyo (Japan). Water Quality Bureau.
For primary bibliographic entry see Field 5G.
W89-03659

AREAWIDE SEWAGE SLUDGE TREATMENT AND DISPOSAL PROJECT -- ACE PLAN,
Japan Sewage Works Agency, Tokyo.
T. Tamaki.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 51-73, 10 fig, 5 tab.

Descriptors: *Recycling, *Sewer systems, *Wastewater treatment, *Sludge, Japan, Digested sludge, Management planning, Organizations.

In the 1986 fiscal year, the Ace Plan, (Agriculture, Construction, and Energy) a new project for areawide sewage sludge treatment and disposal was started in Japan. Municipalities jointly treat and dispose of sewage sludge produced at their wastewater treatment plants. This project not only offers the merit of a large scale operation, but also is expected to facilitate the acquisition of sites for the treatment and disposal of sludge. Sewage sludge is regarded as a rich supply of energy and material, and its recycling and harnessing enable its use as a resource not as a burden. The joint treatment is preferable from the viewpoint of cost as well. The Ace Plan is aided by the Japan Sewage Works Agency's abundant experience and advanced technical know-how regarding sludge treatment and disposal, therefore municipalities can concentrate their efforts on the construction of sewers for the improvement of sanitary services to their constituents. Treasury investments and loans are available for the Ace Plan. Local governments can push forward their areawide sewage sludge treatment and disposal projects without sustaining any initial cost. The Ace Plan integrates the efforts of all the participating local municipalities with the advanced know-how and experience of the Japan Sewage Works Agency to promote the recycling and harnessing of sewage sludge more effectively and efficiently than if they were conducted separately by individual local municipalities. (See also W89-03657) (Davis-PTT)
W89-03660

AUTOGENOUS INCINERATION OF SEWAGE SLUDGE BY RECOVERING THE HEAT OF EXHAUST GAS,
Tokyo Sewerage Bureau (Japan).
K. Osako, and Y. Yabu.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 75-91. 6 fig, 8 tab.

Descriptors: *Wastewater treatment, *Sewer systems, *Sludge utilization, *Japan, *Incineration, Budgeting, Economic aspects.

The Odai sewage treatment plant is one of the ten plants covering the 23 wards of the Metropolitan Tokyo area. It treats the sewage with the capacity of 358,000 cubic meters a day, using the activated sludge process. The sludge pumped out from Ochiai treatment plant (capacity 450,000 cubic meters per day) is also digested, mechanically dewatered, and incinerated at this plant. In order to reduce energy consumption, the following actions were taken: renewal of aeration equipment, introduction of dissolved air flotation process for thickening, and conversion from vacuum filter to belt filter press for dewatering. These resulted in a reduction of moisture content, and an increase in the heating value of polymer cake. The conversion of multiple hearth furnaces, which need renewal, to fluidized bed furnaces is also being implemented. Attempts were made at incinerating sludge without auxiliary fuels by recovering the heat of exhaust gas. The expectation is that heavy oil which supplies 51%, of the total energy, will be eliminated. Digester gas equivalent to 26% of the total energy, will be recovered for electrical use. (See also W89-03657) (Davis-PTT)
W89-03661

BENEFICIAL UTILIZATION OF SEWAGE SLUDGE,
Public Works Research Inst., Tokyo (Japan). Ultimate Disposal Section.
Y. Ohshima.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 93-119. 9 fig, 12 tab.

Descriptors: *Wastewater treatment, *Japan, *Wastewater disposal, *Sludge utilization, Wastewater, Sludge, Dewatering, Incineration, Slag, Roadbed material, Asphalt filler, Ceramic products, Fermentation.

As the population increases and spreads out, the volume of treated wastewater and the volume of sewage sludge increases. An important problem in sewage systems is how to make effective use of these products. The proportion of effectively used sewage sludge is only 10%; the rest is disposed of by land reclamation. The use of sewage sludge for greens and farms is largely restricted by such factors as the control of heavy metals in sewage sludge and soil. The effective utilization of sewage sludge may be divided into utilization as a soil conditioner and fertilizer for greens and farms and utilization as construction materials. The use of sludge as fertilizer is mainly in the forms of dewatered sludge and compost. The use of sludge in construction materials is mostly in the form of incinerated ash but also as artificial light-weight aggregate. The main components of incinerated ash are silicon, calcium, iron, and aluminum. When sewage sludge is heated to 1300 to 1500 centigrade, the organic matter is pyrolyzed and burned and the inorganic matter that remains is melted. Melted slag is obtained by cooling and solidifying this melted solution. Granulated slag is made by suddenly cooling the melted solution. Air-cooled slag is made by cooling the solution in the air. Slag is crystallized to improve surface properties and strength. Incinerated ash can be used as foundation and banking materials, paving and roadbed materials, and in ceramic products. Slag can be used as roadbed material, concrete aggregates, and molded board material. An example is given of how to make ethyl alcohol from mixed sludge. It is desirable to immobilize microorganisms that secrete saccharifying enzymes. Odorants in ethanol must be removed preliminary to the distilling process. (See also W89-03657) (Davis-PTT)
W89-03662

EVALUATION OF ENERGY SAVING USING HEAT BALANCE MODEL FOR MELTING PROCESS,
Japan Sewage Works Agency, Toda. Research and Technology Development Div.
T. Matsui, and T. Murakami.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 121-151. 7 fig, 3 tab.

Descriptors: *Wastewater treatment, *Wastewater, *Sludge utilization, *Japan, Sludge cake, Slag, Economic aspects, Model studies.

A heat balance model for the sludge melting system is proposed. Volume reduction and stabilization of the sewage sludge associated with the melting process are expected to be greater than with the incineration process. Melted slag can be utilized. However, since the melting process requires a very high temperature to melt inorganics in the sludge, the technologies to minimize energy consumption, to establish system operation and to prolong durability of facilities should be developed. A model is prepared that provides the auxiliary fuel consumption of the melting system on the basis of the mass and heat balances. The reflector melting furnace, the cyclon melting furnace and the coke-bed melting furnace all carry out the incineration and melting of cake in one stage. The operational conditions of melting systems depend on the air ratio for melting furnace, the steam supply from the auxiliary boiler, the cake melting temperature, the mixing chambers, the heat recovery, and the dryer. (See also W89-03657) (Davis-PTT)
W89-03663

REUSE OF TREATED WASTEWATER IN FUKUOKA CITY,
Fukuoka City Sewage Works Bureau (Japan). Planning Div.
H. Oniki.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 153-205. 17 fig, 29 tab.

Descriptors: *Wastewater renovation, *Water conservation, *Water reuse, *Japan, Water shortage, Drought, Water deficit, Water scarcity, Economic aspects, Municipal water.

A Model Project for wastewater reclamation and reuse system is reported. In the Fukuoka area, there is no river large enough to meet the water demand. In 1978, the city suffered from a water shortage. A new water policy was instituted to realize the water savings that the city needs. As part of the new policy, the effective use of treated sewage was also included. The first sewage in Fukuoka City was started in 1930, but this was the drain sewer system to drain rainwater and home wastewater. The real sewage was started in 1963 when the first Five-year Sewerage Improvement Plan was enforced. The city depends on dams for its water resources; the rate of intake-water limitation tends to become high during drought. There is

usually a large amount of rainfall during three months from March to May each year. The amount of rainfall from September 1977 to May 1978 was 61% of the average year. The amount of intake-water from rivers decreased. The City Council enacted a water saving policy as of February 1, 1979 which clarifies the responsibility of administration, citizens, and companies, as well as promotes the efficient use of water. It consists of the following sections: promoting water saving awareness and appliances, leak prevention on water distribution lines, and the spread of miscellaneous use waterworks. As of March 1987, 139 facilities applied the inbuilding reclaimed wastewater supply system for miscellaneous reuse. The amount of reused water at each building varies from 6 cubic meters to 520 cubic meters a day. In order to ensure the safety and the efficiency of the reclaimed wastewater, periodic inspection of water quality was done at both reclamation facility and the users' sites. The Aqua-Recycle Town Project is the miscellaneous use water project including Model Project for a wastewater reclamation and reuse system for the central urban area of the city. This will increase the amount of available miscellaneous use water to approximately 12,000 cubic meters a day. (See also W89-03657) (Davis-PTT)
W89-03664

FULL-SCALE EVALUATION OF PHOSPHORUS MASS BALANCE IN BIOLOGICAL PHOSPHORUS REMOVAL PROCESS,
Japan Sewage Works Agency, Toda. Research and Technology Development Div.
N. Taniguchi, T. Murakami, and S. Koike.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 235-264. 20 fig, 4 tab.

Descriptors: *Wastewater treatment, *Sludge, *Phosphorus removal, *Japan, Sludge thickening.

A series of experiments was conducted in the field to clarify the phosphorus removal efficiency and phosphorus mass balance of biological phosphorus removal systems, including the sludge treatment process, and to determine the system with the best biological phosphorus removal efficiency. In checking the adverse effect of the phosphorus load of the return flow from the sludge treatment process on the phosphorus removal efficiency, it was found that phosphorus load of the return flow from the sludge treatment process should be kept less than 50 percent of the phosphorus load of the raw sewage. Experiments disclosed the following requirements to achieve sufficient phosphorus removal. Inorganic coagulant should be dosed to the sludge if gravitational thickening is used. The primary settling tank sludge and the excess sludge should be thickened separately, and the excess sludge should be thickened mechanically. For dewatering, however, it is recommended that the separately thickened sludge be mixed. (See also W89-03657) (Author's abstract)
W89-03666

CURRENT PRACTICES OF BIOLOGICAL NITROGEN REMOVAL PROCESSES IN JAPAN,
Public Works Research Inst., Tokyo (Japan). Advanced Waste Treatment Section.
K. Sato.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988. p 265-290. 10 fig, 9 tab, 2 ref.

Descriptors: *Japan, *Wastewater treatment, *Nitrogen removal, *Phosphorus removal, Nitrification, Denitrification, Sludge.

There are more than 600 municipal wastewater treatment plants operating in Japan. In about 20 of these plants, advanced wastewater treatment processes are applied to produce clearer effluent from those plants using the standard activated sludge mode. Nitrogen and phosphorus removing technologies are also being applied to a limited number of wastewater treatment plants to control nitrification problems in lakes. Four demonstration experiments which have been conducted for nitrogen control of wastewater in Japan are presented. There has been an improvement of the nitrified liquor recycling nitrification-denitrification process at the Konan-Chubu treatment plant of Biwako regional sewerage. There has been an upgrading of the nitrification-endogenous denitrification process in Hamamatsu City. A demonstration study on biological nitrogen and phosphorus removal uses a step inflow process at the Shinjiko-Tobu wastewater treatment plant. The Anaerobic-Anoxic-Oxic process at the Toba wastewater treatment plant of Kyoto City was carried out in an aeration tank which had been remodelled for the flow sheet process. (See also W89-03657) (Author's abstract)
W89-03667

CHARACTERIZATION OF VARIOUS DIFFUSERS AND ITS APPLICATION,
Yokohama City Sewage Works Bureau (Japan). Construction Div.
K. Hosokawa.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 291-344. 5 fig, 6 tab, 7 ref.

Descriptors: *Wastewater treatment, *Sludge, *Aeration, *Japan, *Diffusers, Oxygen transfer.

Aeration is not only an important component of the activated sludge process which directly affects clarification efficiency, but because it consumes 40 to 50 percent of the electric power used at sewage treatment plants,its weight in maintenance management is a large one. A variety of diffusers have been developed. Such diffusion characteristics as bubble size, pore size, and dry air flow rate are widely used in design specifications. The correlation between these characteristics and oxygen transfer efficiency is not clear. There is a lack of basic information needed for the efficient design of diffusers. The relationship between diffuser characteristics and oxygen transfer efficiency was investigated, using 16 diffusers ranging from fine-bubble to coarse-bubble diffusers. Oxygen transfer efficiency for fine-bubble diffusers was 20 to 30 percent while that for coarse-bubble diffusers was 9 to 12 percent. The total surface area of bubbles per air flow rate of 1 liter displayed the highest correlation with oxygen transfer efficiency. The experiments demonstrated an optimum pore size for oxygen transfer efficiency and power consumption efficiency, and revealed the relationship between oxygen transfer efficiency, diffuser placement density, and diffuser distribution. There was little change to the effectiveness of fine-bubble diffusers over a three-year period. The value for oxygen transfer efficiency varied more between sewage treatment plants than between diffusers, revealing that standardized procedures need to be established to accurately measure oxygen transfer efficiency. An understanding useful for diffuser design was gained in such areas as the relationship between oxygen transfer efficiency, inorganic salt, and surface active agents.(See also W89-03657) (Author's abstract)
W89-03668

PROGRESS IN THE RESEARCH ON APPLICATION OF BIOTECHNOLOGY ON WASTEWATER TREATMENT,
Ministry of Construction, Tokyo (Japan). Dept. of Sewerage and Sewage Purification.
S. Andoh.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 345-364. 3 fig, 5 tab.

Descriptors: *Research and development, *Biological wastewater treatment, *Energy, *Water quality standards, *Japan, Effluent quality, Sludge, Bioreactors, Biosensors, Nitrogen removal, Phosphorus removal.

A five year research project called the 'Development of New Wastewater Treatment Systems Employing Biotechnology' was started by the Ministry of Construction in 1985. The research and development plan for new wastewater treatment systems utilizing biotechnology includes: the study for the development of a microorganism bank, the study of the application of genetic engineering on microorganisms for wastewater treatment, the study of immobilization methods, the study of bioreactors for wastewater treatment, the study of bioreactors for sludge treatment, the study of biosensors, the study of solids/liquid separation units, and the study for systematizing the developed techniques. The Bioreactors for wastewater treatment to be developed are for removing organic substances, nitrogen, and phosphorus simultaneously, and for removing trace substances. The study of bioreactors for sludge treatment is being performed to enhance the efficiency of anaerobic digestion, to remove heavy metals from sludge using microorganisms, for accelerating the effective utilization of sludge, recovering protein, and to recover valuable resources from sludge. Practical biosensors are being developed which use vital reactions for improving environmental measurement and process control in wastewater treatment. (See also W89-03657) (Davis-PTT)
W89-03669

SLUDGE MANAGEMENT AND ENERGY PRODUCTION AT LOS ANGELES COUNTY SANITATION DISTRICTS,
Los Angeles County Sanitation Districts, Whittier, CA.
J. F. Stahl, and R. W. Horvath.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 391-420. 15 fig.

Descriptors: *Los Angeles, *California, *Wastewater facilities, *Wastewater treatment, *Sludge, Anaerobic digestion, Gas utilization, Dewatering, Sludge utilization, Agricultural utilization.

The County Sanitation Districts of Los Angeles County operate a regional sewerage system. A network of wastewater collection, treatment, reclamation and disposal facilities serve all or portions of 76 cities with a combined population of approximately 4 million people. The largest treatment plant is the Joint Water Pollution Control Plant (JWPCP) located in the City of Carson. There are also five inland water reclamation plants. Each of these five inland plants intercepts only a part of the flow at each location, with the remainder flowing to the (JWPCP). Solids from these plants are also returned to the sewer and carried by sewage to the (JWPCP). At the (JWPCP), all wastewater first undergoes primary settling, aided by addition of anionic polymers, which results in over 80 percent removal of suspended solids. About 60 percent of the primary effluent receives further treatment by pure oxygen activated sludge. All primary and thickened waste activated sludge produced at the (JWPCP) is anaerobically digested. Dewatered sludge production from the (JWPCP) for 1986 averaged, on a wet basis, 1320 metric tons per day. Composting, the preferred method for sludge disposal, produces a product for beneficial reuse, uses little energy, and is lowest in cost. However, its capacity is limited by land availability, and because it represents a significant odor source at the site. Landfill gas must be collected as a safety measure to prevent migration to surrounding areas, and for odor and air pollution control. Increasing sludge production from improved wastewater treatment, decreasing landfill capacity, and the need to develop more reliable wet weather disposal capacity led the Districts to seek an additional means of sludge disposal. The Carver-Greenfield dehydration system will be used to convert the digested, dewa-

tered sludge to a dry powder. (See also W89-03657) (Davis-PTT)
W89-03671

SELECTED MUNICIPAL SLUDGE TOPICS.
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
C. A. Brunner.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 421-441. 5 fig, 4 tab, 8 ref.

Descriptors: *Wastewater treatment, *Sludge disposal, *Regulations, Liquid fuel, Wet oxidation, Vertical reactor, Sludge utilization.

The amount of sludge from municipal wastewater treatment plants is increasing in the United States as is resistance to its disposal. The Environmental Protection Agency adopted the concept of risk assessment as the basis for a set of sludge disposal regulations. For each disposal method, a list of toxic materials judged likely to have the most severe effect on human health was prepared and a maximum exposed individual (MEI) was defined. A three-tiered regulatory approach was developed that would allow different degrees of consideration to be given to site-specific factors. The Environmental Protection Agency also carried out an aggregate risk assessment that produced an estimate of the national impact of sludge disposal. The unreviewed results indicate a low incidence of negative health effects under existing conditions. Conversion of municipal treatment plant sludge to fuel eliminates the problem of disposal and provides income from sale of the fuel or saves operating expense through use in the treatment plant. Although the feasibility of recovering about one-half of the thermal energy in sludge as a liquid fuel has been shown, the economics of a full-scale system need to be determined. A full-scale vertical reactor for wet oxidation of municipal wastewater sludge was constructed at Longmont, Colorado in 1983 and has been operating on the sludge from that community. In the United States, about 40 percent of the sludge is disposed to solid waste landfills. A four-year study revealed that leachate was not produced immediately nor even after early additions of simulated rainwater. The addition of municipal wastewater sludge to solid waste landfills was not environmentally detrimental. To provide information on the relative destruction of pathogenic microorganisms in sludges from conventional activated sludge compared to extended aeration, a side-by-side continuous pilot study was carried out using the same wastewater feed. The longer solids retention time process, extended aeration, results in a greater reduction of indicator organisms. (See also W89-03657) (Davis-PTT)
W89-03672

STATUS OF THE POTABLE WATER REUSE DEMONSTRATION PROJECT AT DENVER,
Denver Reuse Plant, CO.
W. C. Lauer, and J. J. Convery.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 443-474. 4 fig, 10 tab, 4 ref, 5 append.

Descriptors: *Water reuse, *Wastewater renovation, *Potable water, Denver, Ammonia concentration, Nitrogen concentration, Pressure filtration, Carbon adsorption, Ozone, Reverse osmosis.

The Denver Potable Water Reuse Demonstration Project the project is designed to determine the feasibility of renovating secondary treated wastewater to potable water including resolution of the issues of water quality safety, process dependability, economics, regulatory agency approval, and social acceptability. The 1.0 MGD Demonstration Facility at Denver began operation on October 1, 1985. The Process Flow Scheme consists of: single stage of lime clarification, recarbonation, pressure filtration, selective ion exchange for ammonia removal, first-stage activated carbon adsorption, ozonation, second-stage activated carbon adsorption, reverse osmosis, air stripping and chlorine dioxide disinfection. With the exception of turbidity, fluoride, asbestos, and the microbiological parameters, the measured Reuse Plant Influent Parameters satisfy all existing and proposed primary drinking water standards. The results are either lower than or not significantly different from Denver drinking water for every parameter tested except boron, ammonia-N, and total Kjeldahl Nitrogen. Two of the three multi-media pressure filters operated simultaneously; they removed an average of 78 percent of the influent turbidity. The Phase I results showed that the Reuse Plant effluent satisfies all of the primary, secondary and proposed recommended Maximum Contaminant Levels except pH. The Phase I operating results indicate that high quality water can be reliably produced at an operating cost of $3.60 per thousand gallons. (See also W89-03657) (Davis-PTT)
W89-03673

SUMMARY OF CHEMICAL AND BIOLOGICAL PHOSPHORUS REMOVAL EXPERIENCE IN NORTH AMERICA,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
R. C. Brenner, and D. J. Lussier.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 603-667. 26 fig, 22 tab, 8 ref.

Descriptors: *Phosphorus removal, *Nitrogen removal, *Wastewater treatment, Organic carbon removal, Suspended solids removal, Disinfection, Sludge, Economic aspects.

The need to control phosphorus and nitrogen concurrently is being encountered frequently today. These requirements may take the form of combined phosphorus removal-nitrification or combined phosphorus removal-nitrogen removal. Over 15 years of experience with chemical phosphorus removal has produced a high degree of confidence in the technology's ability to meet a wide range of effluent standards. Biological phosphorus removal is relatively new. Although some biological phosphorus removal approaches possess inherent potential advantages over mineral addition, their eventual acceptance and usage with the chemical alternative will depend on their ability to provide long-term reliable operation and performance. Lower effluent phosphorus concentrations can more consistently be attained with the sidestream PhoStrip biological phosphorus removal process than with the mainstream biological phosphorus removal processes. Recycle of significant quantities of solubilized phosphorus in digester supernatants back to the main plant flow is a distinct possibility that must be considered with some biological phosphorus removal options. Lower mineral salt dosages appear to be required with activated sludge plants than with plants employing fixed film biological systems. Part of the higher dosages required with the fixed film systems may be attributable to the generally shallower and less-conservatively designed final clarifiers provided in many older trickling filter plants. Biological phosphorus removal technology offers a variety of options for effectively combining nitrogen control with phosphorus removal. However, combining nitrogen and phosphorus control in a single biological system requires careful design to avoid upsetting the operation and efficiency of the anaerobic zone. (See also W89-03657) (Davis-PTT)
W89-03675

STATUS OF FINE PORE AERATION IN THE UNITED STATES,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
R. C. Brenner, and W. C. Boyle.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 669-701. 9 fig, 7 tab, 11 ref.

Descriptors: *Aeration, *Wastewater treatment, *Energy, *Fine pore diffusers, Oxygen demand, Flow regime, Cleaning techniques, Oxygen transfer.

Fine pore diffused aeration has become a major force in the United States aeration market. The effect of process operating conditions and the impact of diffuser cleaning on fine pore diffused aeration performance and design are described. The American Society of Civil Engineers Committee on Oxygen Transfer is composed of 50 volunteer engineers and scientists, primarily from the United States, but with representation from Canada, Sweden, the United Kingdom, and West Germany. The Steering Subcommittee meets four to five times a year to review progress on all phases of the project and to make mid-course changes in direction as needed. Fifteen major field studies have been funded by the Steering Subcommittee to generate the data necessary. The study sites and descriptions, as presented in a table, include: Whittier Narrows, CA; Terminal Island, CA; Frankenmuth, MI; Monroe, WI; Madison, WI; Hartford, CT; Glastonbury, CT; Ridgewood, NJ; Dallas, TX; Milwaukee, WI; Valencia, CA; and Northern Europe. Fine pore diffuser fouling in the United States does not appear to be as prevalent or severe as first contemplated. Other factors, most notably wastewater characteristics and process operating conditions, play a larger role than fouling in lower field oxygen transfer efficiency for some fine pore diffuser installations. A correlation appears to exist between fine pore diffuser performance and solids retention time. Increasing solids retention time promotes improved diffuser performance. Preliminary information indicates that plug flow operation may produce a higher standard oxygen transfer efficiency values than the step aeration mode of operation. Rigorous cleaning, while necessitating tank draining and process interruption, is effective in restoring ceramic diffuser field oxygen transfer efficiency to like new conditions. Internal acid gas cleaning effectiveness in restoring ceramic fine pore diffuser performance and or retarding the rate of field oxygen transfer efficiency loss appears to be site specific. (See also W89-03657) (Davis-PTT)
W89-03676

SELECTED INNOVATIVE AND ALTERNATIVE TECHNOLOGY DEVELOPMENTS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. J. Convery, J. F. Kreissl, J. A. Heidman, R. C. Brenner, and R. A. Dobbs.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 785-824. 11 fig, 14 tab, 8 ref.

Descriptors: *Wastewater treatment, *Technology, *Economic aspects, Trickling filters contact, Two-zone process, Sludge drying, Gates, Ion exchange, Clarifiers.

New technologies for municipal wastewater treatment facilities are discussed. The trickling filter/solids contact (TF/SC) process is a biological and physical process that includes a TF, an aerobic solids contact basin, a flocculation zone, and a secondary clarifier. Most of the operating trickling filter plants use rock media. Work at the Morro Bay-Cayucos plant and at the Coeur d'Alene plant showed that effluent quality could be improved by replacing conventional secondary clarifiers with flocculator-clarifiers. The Two-Zone Process, which can be retrofilted to upgrade existing aerators or clarifiers, uses the lower portion of the tank as a biological reactor and the upper portion as the clarifier. Flow and load equalization should be provided whenever the peak-to-average hydraulic

loading ratio and carbonaceous loading ratio, exceed 2.4 to 2.5 respectively. Influent flows to the Two-Zone Process should be pretreated with fine screening and primary treatment to avoid fouling of the oxygenator. A 0.07 MGD pilot plant study was conducted in South Lynn, MI to evaluate the Rim-Nut Process. This is a physical-chemical process which utilizes selective ion-exchange resin to remove both ammonium and phosphate ions from wastewater and recover ammonium magnesium phosphate. The rubber tide gate, based upon a check valve concept, provides a potential low maintenance and cost effective alternative to conventional flap gates. During the 18 month evaluation period of the rubber tide gate, it required almost no maintenance and indicated negligible inflow with good sealing and self-cleaning characteristics. (See also W89-03657) (Davis-PTT)
W89-03678

PROBABILISTIC MODELS FOR COMBINED SEWER SYSTEM REHABILITATION ANALYSIS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. J. Adams, and G. Zukovs.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 97-108, 15 fig, 6 ref.

Descriptors: *Systems analysis, *Probabilistic process, *Model studies, *Sewer systems, *Rehabilitation, *Decision making, *Storm-overflow sewers, Administrative decisions, Case studies, Hydrology, Hydraulics, Water quality management, Pollution load, Performance evaluation, Storage, Outfalls, Cost analysis, Sewer separation, Sewer hydraulics.

Many major urban centers are still serviced by combined sewers in large portions of their drainage systems. In general, combined drainage systems are aged and are in need of rehabilitation. These systems suffer from structural inadequacies, as well as problems related to their capacity or performance with respect to water quality. A decision framework is presented using derived probability (analytical) models for the evaluation of combined sewer overflow (CSO) quality control measures. The models are closed-form analytical solutions of the probability density functions of system hydrologic and hydraulic behavior. A case study examining the impact of various control strategies upon CSO volumetric and pollutant mass loading frequency is presented. It is concluded that combined sewer system performance must be analyzed over the complete spectrum of system operating conditions in order to evaluate rehabilitation alternatives meaningfully. Also, (1) downstream storage and increased interceptor capacity are the most effective single alternatives for reducing the average annual pollutant loads to receiving waters; (2) no single alternative is effective for low-frequency overload reduction unless employed on a very large scale; and (3) downstream storage combined with outfall treatment is very effective for the average annual and low frequency load reduction. (See also W89-03679) (Doria-PTT)
W89-03689

REAL TIME OPERATION OF URBAN DRAINAGE SYSTEMS-VALIDITY AND SENSITIVITY OF OPTIMIZATION TECHNIQUES,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
W. Schilling, and S. O. Petersen.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 259-269, 5 fig, 2 tab, 10 ref.

Descriptors: *Urban drainage, *Drainage systems, *Optimization, *Water transport, *Linear programming, *Systems analysis, Simulation, Sewer systems, Sewers, Combined sewers, Pumping, Runoff, Storm runoff, Forecasting, Runoff forecasting.

Various concepts for the real time control of wastewater transport systems are described. The problem of automatic systems control is formulated as a linear programming problem. Possible difficulties in the quantification of the objective function and the constraints are discussed. The necessary simplifications are validated by comparison with detailed process simulations. Sensitivity with respect to the formulation of the objective function and with respect to errors of inflow forecasts are investigated. It is concluded that optimal real time control allows an absolute evaluation of the system performance before the control is actually executed. A case study shows considerable freedom in the formulation of the control task as a mathematical optimization problem. Simplifications with respect to both operational objectives and hydraulic dynamics are necessary, although their adverse effects can be accounted for through detailed verification. Maximum control success can be achieved only if inflow forecasts are available. The necessary control horizon is usually much less than the emptying time of the system. Volumetric errors can be tolerated to some extent but a forecasting model should not be biased towards underforecasting. (See also W89-03679) (Doria-PTT)
W89-03705

APPLICATION OF SYSTEMS ENGINEERING CONCEPTS TO COMBINED SEWER OVERFLOW CONTROL AT SEATTLE METRO,
Municipality of Metropolitan Seattle-METRO, WA. Technical Services Dept.
Z. Vitasovic, R. Sandaas, and B. Nitz.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 271-281, 5 fig, 9 ref.

Descriptors: *Systems analysis, *Washington, *Systems engineering, *Combined sewers, *Storm-overflow sewers, *Seattle, *Model studies, Engineering, Sewers, Computers, Computer models, Routing, Forecasting, Runoff forecasting, Storage.

The Municipality of Metropolitan Seattle (Metro) has been using a computer to control a combined sewer collection system since 1972. This system, called CATAD (Computer Augmented Treatment And Disposal), controls pumping and regulator stations in order to use the storage volume available in the collection system to reduce sewage spills into the environment. This system is currently being updated by a Systems Engineering Group within Metro. The plan for the development of the adaptive control system consists of the following main tasks: routing model development, runoff model development, data base development, forecasting model, control strategies, instrumentation upgrade in remote stations, and facilities inventory. Metro has determined that the improved use of existing pipe storage through computer control (software storage) is a very cost-effective alternative to many of the typical combined sewer overflow control measures. (See also W89-03679) (Doria-PTT)
W89-03706

ON-LINE PREDICTION OF INFLUENT PHOSPHORUS LOAD OF WASTEWATER TREATMENT PLANTS,
Beijing Normal Univ. (China). Research Inst. of Environmental Science.
H. Ranjie, and H. H. Hahn.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 343-347, 5 fig, 3 ref.

Descriptors: *Wastewater treatment, *Phosphorus, *Model studies, *Prediction, Wastewater facilities, Process control.

A prediction-feedforward control scheme is suggested to measure the influent phosphorus concentration at wastewater treatment plants. The method is proposed based on the Group Method of Data Handling (GMDH), which allows prediction of the variation of concentration of influent wastewater one step in advance (e.g., one hour or one day). The principle of GMDH is described, along with the structural form of prediction models, the arrangement of data, and the result of applying the method to real data collected from several German wastewater treatment plants. Only 26 measurements are needed to construct the prediction model that gives the desired level of accuracy. It is concluded that the method has the advantage of requiring only a small amount of data. Moreover, the soft structure of the prediction model makes it possible to reflect a slow change in predicted values. This will be very helpful for developing a reliable prediction-feedforward control system. (See also W89-03679) (Doria-PTT)
W89-03714

DYNAMIC MODELLING, ESTIMATION AND CONTROL OF ACTIVATED SLUDGE SYSTEMS,
Lund Univ. (Sweden). Dept. of Automatic Control.
G. Olsson.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 349-356, 25 ref. Swedish Board for Technical Development Contract 86-3552.

Descriptors: *Systems analysis, *Model studies, *Wastewater treatment, *Estimating, *Activated sludge process, *Process control, Simulation, Sludge, Activated sludge, Sludge thickening, Model testing, Sedimentation, Clarifiers, Clarification, Aerators, Aeration.

Dynamic modeling is an essential tool for condensing the understanding of time-varying behavior in wastewater treatment systems. A dynamic model library for activated sludge plants has been developed at the Lund Institute of Technology, Sweden. The library provides a framework to collect different approaches to aerator and settler models in a unified manner. The simulation language Simion has proved to be an excellent shell for the library system descriptions. Modules of different complexity can be combined. For example, an anoxic reactor can be connected to nitrifying reactors. Also, by allowing several influent and effluent streams at each module, all possible combinations of step feed or recirculation flows can be combined into a realistic plant configuration. Controllers are represented as separate systems. The library currently contains seven different basic aerator modules. The verification of these models remains to be completed. Examples of the use of the models are presented, and the use of recursive estimation and adaptive control to improve operation and understanding of the process is discussed. (See also W89-03679) (Doria-PTT)
W89-03715

OPERATIONAL WATER QUALITY MANAGEMENT: A SENSE OF PERSPECTIVE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-03716

LEARNING PRODUCTION SYSTEM FOR THE CONTROL OF URBAN SEWER SYSTEMS,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
L. Fuchs, D. Muller, and A. Neumann.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 411-421, 10 fig, 7 ref.

Descriptors: *Systems analysis, *Process control, *Sewer systems, *Combined sewer overflows, *Artificial intelligence, *Automation, Overflow, Runoff, Optimization, Algorithms, Catchment areas, Water quality management, Model studies, Rainfall-runoff relationships.

To reduce combined sewer overflows, to equalize the runoff to treatment facilities, and to reduce energy costs, on-line and real-time control of a sewer system is a possible solution. To find out the best control strategy, methods of artificial intelligence can be used besides numerical optimization. The general working algorithm of a learning production system is described and explained by simple examples. For the sewer network of the city of Bremen, West Germany with a catchment area of about 1000 ha, 3500 inlet areas, detention basins,

and pumping stations, a learning production system was developed and tested in a simulated on-line mode. The control strategies of the learning production system for some events were compared with those of numerical optimization and existing control rules. It is shown that the learning production system leads to control strategies that are adequate to those derived from numerical optimization and they cause similar energy costs or overflow volumes. The advantages of the learning production system lie in high flexibility, transparent control decisions, and very fast computation. (See also W89-03679) (Author's abstract)
W89-03721

RULE-BASED CONTROL SYSTEM FOR THE ACTIVATED SLUDGE PROCESS,
Municipality of Metropolitan Seattle-METRO, WA.
Z. Vitasovic, and J. F. Andrews.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 423-432, 6 fig, 1 tab, 20 ref. NSF Grant CEE 8204051.

Descriptors: *System analysis, *Expert systems, *Process control, *Activated sludge process, *Wastewater treatment, *Automation, *Model studies, Oxygen uptake, Computers, Sludge, Activated sludge, Oxygen, Dissolved oxygen, Oxygen demand, Biological oxygen demand, Ammonia, Nitrites, Nitrates, Bacteria, Nitrogen fixing bacteria.

A rule-based control system using on-line estimates of the specific total oxygen uptake rate (STOUR) and manipulation of the distribution of influent wastewater between reactors is presented for the activated sludge process. STOUR estimates for each of four reactors in series are used to estimate the state of the process, and manipulation of the wastewater feed rate to each reactor is used to change STOUR profile. Computer simulations using a dynamic model indicate that the control system can maintain a given STOUR profile which, in turn, has the potential for improving sludge settling characteristics. (See also W89-03679) (Author's abstract)
W89-03722

PROMISING AND AFFORDABLE SOLUTION TO SLUDGE TREATMENT,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168398. Price codes: A03 in paper copy, A01 in microfiche. Technical Paper No. LIR/05-86/176, May 20, 1986. 12p, 3 fig, 4 tab, 7 ref.

Descriptors: *Sludge digestion, *Economic aspects, *Sludge disposal, *Wastewater treatment, Ozonation, Sludge drying, Flotation, Waste recovery, Case studies, Sludge thickening.

The process concepts, facilities, case histories, and advantages of an innovative sludge ozonation and dewatering system (Oxyozosynthesis) are introduced. The new system is specifically designed for affordable sludge disinfection, stabilization, thickening and dewatering in industrial urban areas. Major unit operations and processes include: (a) sludge collection, flow equalization and pH adjustment in a wet well; (b) oxygenation and ozonation of sludge in a pressurized vessel; (C) flotation thickening ; (d) sludge press dewatering; and (e) resource recovery as fuel, or ultimate disposal by sanitary landfill. Two full-scale oxyozosynthesis systems have been installed at the West New York and Hoboken Sewage Treatment Plants, both in the State of New Jersey. Actual operational data are presented. (Author's abstract)
W89-03733

CLOSING THE WATER SYSTEM ON PAPER MACHINES WITH A HIGH-RATE FLOTATION CLARIFIER,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5G.
W89-03734

DISSOLVED AIR FLOTATION PROCESSES,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168448. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. LIR/111-86/219, November 5, 1986. 35p, 29 fig, 1 tab.

Descriptors: *Water treatment, *Acidification, *Lake restoration, *Wastewater treatment, *Flotation, Clarification, Supracell, Sandfloat, Floatpress, Sedifloat, Flocculation, Filtration, Sludge, Algae, Phosphorus.

The theories and applications of various dissolved flotation clarifiers (Supracell, Sandfloat, Floatpress and Sedifloat) are presented. Supracell is a high-rate dissolved air flotation clarifier with only 3 to 5 minutes of detention time. Major application of Supracell is industrial effluent treatment. Sandfloat is a package plant consisting of flocculation, dissolved air flotation and automatic backwash filtration, and designed for either potable water treatment or tertiary wastewater treatment. Sedifloat is a wastewater treatment package plant consisting of both sedimentation and dissolved air flotation. Floatpress consists of both dissolved air flotation and filter press and is specifically designed for sludge thickening. A Krofta Bargefloat is a floating lake water clarification plant designed for acid rain neutralization, phosphorus removal, algae removal and lake water purification. Bargefloat has built-in chemical feeders, flocculator, dissolved air flotation clarifier and sand filter on a barge. (Author's abstract)
W89-03735

HAZARDOUS WASTE SITE MANAGEMENT: WATER QUALITY ISSUES. REPORT ON A COLLOQUIUM SPONSORED BY THE WATER SCIENCE AND TECHNOLOGY BOARD. COLLOQUIUM 3.
National Research Council, Washington, DC. Water Science and Technology Board.
For primary bibliographic entry see Field 5E.
W89-03783

HOW CLEAN IS CLEAN. THE NEED FOR ACTION,
General Electric Co., Fairfield, CT.
For primary bibliographic entry see Field 5G.
W89-03787

HOW CLEAN IS CLEAN. AN ENVIRONMENTALIST PERSPECTIVE,
Environmental Defense Fund, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-03788

START-UP AND OPERATION OF THE INDIANAPOLIS OZONE DISINFECTION WASTEWATER SYSTEMS,
Process Applications, Inc., Fort Collins, CO.
K. L. Rakness, R. C. Renner, D. B. Vornehm, and J. R. Thaxton.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 215-240, 1988. 12 fig, 4 tab, 7 ref.

Descriptors: *Ozone, *Wastewater treatment, *Ozonation, *Wastewater facilities, *Disinfection, *Indianapolis, Activated sludge process, Indiana, Performance evaluation, Capital costs, Operating costs, Maintenance costs.

The two 125-mgd oxygen activated sludge wastewater treatment plants for the City of Indianapolis, Indiana use ozone disinfection. The process was constructed in 1983, and has maintained continuous, reliable operation since 1985. Disinfection is required at Indianapolis from April 1 through October 31. Equipment performance characteristics were evaluated during the 1985 disinfection season, and disinfection performance characteristics were optimized during the 1986 season. The evaluation documents the effect of cooling water temperatures on equipment performance, and the utilization of ozone contactor off-gas control of disinfection performance. The capital cost of both ozone systems represented about eight percent of the plants' total construction cost. The ozone system operating and maintenance cost represents about 1.9% and 3.7% of the total plant operating and maintenance cost at the Belmont and Southport plants, respectively. (Author's abstract)
W89-03907

DOMESTIC AND INDUSTRIAL WASTEWATER TREATMENT WITH OZONATED ACTIVATED SLUDGE,
Pretoria Univ. (South Africa).
H. van Leeuwen.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 291-307, 1988. 7 fig, 4 tab, 15 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Ozonation, *Industrial wastes, *Domestic wastes, Settling velocity, Nitrification, Phosphorus removal, Disinfection, Biological wastewater treatment, Nutrient removal.

Direct ozonation in the aerobic zone of nutrient removal activated sludge systems treating domestic wastewater improves the removal of organic substances, aids nitrification and, to some extent, phosphate removal enhances beneficial biological activity, and leads to an effluent more suitable for reuse than activated sludge treatment without ozonation. This improvement in effluent quality was not found in activated sludge treatment of synthetic fuel wastewater. Direct ozonation in activated sludge systems can improve sludge settleability through suppression of either the growth of filamentous organisms or zoogleal bulking. Resultant cost savings in settling and sludge handling can fully offset ozonation costs and produce clearer effluents in both domestic and synthetic fuel wastewater treatment. (Author's abstract)
W89-03911

APPLICATIONS OF OZONE IN JAPAN FOR WATER AND WASTEWATER TREATMENT,
Ebara Research Co. Ltd., Fujisawa (Japan).
S. Yasutake, M. Kato, and S. Kono.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 309-320, 1988. 8 fig, 3 tab.

Descriptors: *Ozone, *Wastewater treatment, *Water treatment, *Ozonation, *Japan, Disinfection, Ultraviolet radiation, Industrial wastes, Odors, Organic carbon, Recycling, Color, Potable water.

In Japan, ozone is used for potable water treatment, night soil and industrial wastewater treatment, and for offensive gas treatment at sewage and night soil treatment plants. In eight potable water plants, ozone removes odors and colors successfully. The combined ozone/ultraviolet radiation process now is available as a new type of ozonation process. With this method, it was possible to reduce the applied ozone dosage required for odor removal in potable water treatment by about 30%. At the same time, an increased disinfection effect was obtained. (Author's abstract)
W89-03912

COMPARISON OF OZONE AND OXYGEN MASS TRANSFER IN A LABORATORY AND PILOT PLANT OPERATION,
Energoprojekt, Belgrade (Yugoslavia). Hidroinzenjering.
I. Stankovic.
Ozone science and Engineering OZSEDS, Vol. 10, No. 3, p 321-338, 1988. 9 fig, 3 tab, 18 ref.

Descriptors: *Ozone, *Ozonation, *Mass transfer, *Oxygen, *Model studies, *Pilot plants, Bubbles, Wastewater treatment, Water treatment, Mathematical studies.

The mass transfer model for a pilot plant bubble column was developed from the concentration gradients along the column, during batch and steady state operation. A correlation between the superficial gas velocity and the overall physical volumetric mass transfer coefficient was obtained for ozone and oxygen. In a laboratory stirred reactor, ozone

and oxygen mass balances were made on both the liquid and the gaseous phases under batch and steady state conditions. A correlation between overall physical volumetric mass transfer coefficient and the agitational speed was obtained for different gas and liquid flow rates. Specific interfacial area was determined by a photographic technique and holdup measurements in a bubble column, and by the oxidation of aqueous sodium sulfite solution in a laboratory stirred reactor. Physical mass transfer coefficients were compared for ozone and oxygen, and showed good agreement with the literature data. (Author's abstract)
W89-03913

CHLORINATION VS. ALTERNATIVE DISINFECTANTS: WHICH IS THE BEST CHOICE,
Greeley and Hansen, Chicago, IL.
T. E. Wilson, and M. Hsu.
Water Engineering and Management WENMD2, Vol. 135, No. 10, p 42-43, 45, October 1988.

Descriptors: *Chlorination, *Disinfection, *Ozone, *Ultraviolet radiation, Water treatment, Capital costs, Sulfur dioxide, Wastewater facilities, Wastewater treatment.

Municipalities are increasingly required to meet more stringent effluent chlorine standards. Ultraviolet light (UV) and ozone are the most common chlorine alternatives. For small plants (below 2 mgd), UV is cost competitive with chlorination/dechlorination and has the advantages of safety, simplicity and no known toxic effluent product. The inability of UV to produce high levels of disinfection (2.2 coliform/100 ml) may limit its application. Sizing of UV equipment is site specific and often requires pilot studies. Ozone is typically more expensive than chlorination/dechlorination and is most attractive for large plants (over 10 mgd). Ozone has the advantages of leaving a highly polished, oxygen rich effluent and no known serious toxic effluent products. In some instances chlorine must be added to ozonated effluent to reach required disinfection standards. If chlorine is used as a disinfectant, dechlorination may be required to meet new standards. Common dechlorination methods are granular activated carbon, storage, sulfite compounds, and sulfur dioxide. Storage of effluents for dechlorination could be attractive for small plants where land is cheap. Chlorine removal may require about 20 storage hours per mg/l of chlorine removed. Sulfites dechlorinate in the same manner as sulfur dioxide but are much more expensive. Sulfonation (SO2 feed) systems are similar to chlorination systems and generally consist of sulfonators, evaporators, ejectors, diffusers and storage. The simple feed-forward system is the most common system for controlling SO2 dosage. The SO2 dosage is adjusted according to wastewater flow and residual chlorine concentration. The capital cost of SO2 dechlorination is site specific, depending on chlorine residuals, the need for additional structures, and railroad sidings. To construct and operate a typical system with minimal structural additions or changes, approximate costs are $40,000 for a 1 mgd facility with 2.0 c/1,000 gal. operating and maintenance on the basis of 3 mg/l SO2 dosage. (Geiger-PTT)
W89-03914

HYDROGEN PEROXIDE TREATMENT OF SEPTIC SYSTEMS AND ITS NEGATIVE EFFECTS ON SHALLOW GROUND WATER,
Illinois Univ., Urbana. Dept. of Agronomy.
T. J. Bicki.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 108-111, Fall 1988. 4 fig, 19 ref.

Descriptors: *Septic tanks, *Groundwater pollution, *Water pollution sources, *Soil absorption capacity, *Hydrogen peroxide, *Nitrates, Nitrogen, Infiltration, Absorption, Septic wastewater, Wastewater oxidation, Clogging, Monitoring, Test wells, Sampling.

Soil-solution samplers and shallow groundwater monitoring wells were utilized to monitor nitrate movement to groundwater following hydrogen peroxide (H2O2) application to a clogged soil absorption system. Nitrate-nitrogen concentrations in soil water and shallow groundwater ranged from 29 to 67 mg/L and 9 to 22 mg/L, respectively, prior to H2O2 treatment. Mean nitrate-nitrogen concentrations in soil water and groundwater increased and ranged from 67 to 115 mg/L and 23 to 37 mg/L, respectively, one week after H2O2 application. Elevated concentrations of nitrate-nitrogen above background persisted for several weeks following H2O2 treatment. The H2O2 treatment was unsuccessful in restoring the infiltrative capacity of a well-structured soil. Application of H2O2 to the soil absorption system poses a threat of nitrate contamination of groundwater and its usefulness should be fully evaluated before rehabilitation is attempted. (Author's abstract)
W89-03926

REMOVAL OF OIL FROM WASTEWATER BY AIR FLOTATION: A REVIEW,
American Inst. of Chemical Engineers, New York.
G. F. Bennett.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 18, No. 3, p 189-253, 1988. 26 fig, 50 tab, 163 ref, append.

Descriptors: *Wastewater treatment, *Oil recovery, *Industrial wastes, Reviews, Separation techniques, Ultrafiltration, Chemical treatment, Air pollution, Bubbles, Flotation, Cost analysis, Waste management, Grease, Industrial wastewater.

Oil and grease are common industrial pollutants whose removal is normally effected by gravity separation followed by a chemically enhanced air separation process. In this review, oil and grease, their sources, their analysis, and their removal are discussed. Although removal by chemical treatment gravity separation, and ultrafiltration are discussed initially, the major thrust of the review is removal of oil by air bubbles. The theory of flotation and equipment involved are discussed. The various mechanisms of bubble generation (i.e., dissolved, induced, or nozzle air flotation systems) are described. Many performance data are given for numerous types of industrial wastewaters in one of several air flotation systems. Aspects of air pollution, handling of the recovered product, and costs are considered. (Author's abstract)
W89-03930

RECLAMATION OF MUNICIPAL WASTEWATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
F. A. El-Gohary, S. I. Abo-Elela, and H. M. El-Kamah.
Science of the Total Environment STENDL, Vol. 72, p 167-174, June 15, 1988. 4 fig, 1 tab, 7 ref.

Descriptors: *Water reuse, *Wastewater renovation, *Municipal wastewater, *Wastewater, *Wastewater treatment, Coagulation, Nitrification, Effluents, Chlorides, Toxicity, Flocculation, Pilot plants, Fish, Bioassay.

The feasibility of applying direct, advanced treatment to municipal wastewater has been investigated. A two-stage scheme was implemented. The first stage was direct chemical coagulation of primary effluent using different coagulants to remove suspended solids and reduce the carbon-to-nitrogen ration to a range suitable for nitrification. The second stage was the use of a biological sand-bed to oxidize ammonia to nitrate. The pilot plant was designed to treat 6 cubic meters per day. The results obtained show that chemical coagulation using ferric chloride gives high quality effluent suitable for agricultural purposes. Nitrification of the chemically treated effluent using a sand-bed at an overflow rate of 1.358 cubic meters per square meter per day completely eliminated ammonia. Almost complete removal of suspended solids was achieved. Residual COD and BOD values were 45 and 15.5 mg per liter respectively. Fish biotoxicity was completely eliminated after the nitrification process. (Author's abstract)
W89-03945

CHARACTERISATION OF METAL FORMS IN SEWAGE SLUDGE BY CHEMICAL EXTRACTION AND PROGRESSIVE ACIDIFICATION,
Consultants in Environmental Sciences Ltd., London (England).
For primary bibliographic entry see Field 7B.
W89-03962

CONTROL PLAN FOR SEATTLE METRO'S CSOS,
CWC-HDR, Inc., Edmonds, WA.
G. Culp, J. Lampe, and P. Arsenault.
Water Engineering and Management WENMD2, Vol. 135, No. 9, p 32, 34-37, September 1988. 1 tab.

Descriptors: *Seattle, Washington, *Combined sewer overflows, *Wastewater collection, *Sewer separation, *Planning, Process control, Overflow, Sewer systems, Model studies, Land use, Wastewater treatment, Secondary wastewater treatment, Water conveyance, Storage, Pipelines, Runoff, Drainage, Urban drainage.

Metropolitan Seattle is required by law to upgrade its four existing primary treatment plants to provide secondary treatment by the early 1990s and to achieve the greatest reasonable reduction of combined sewer overflows (CSOs) by the earliest possible date. The city's plans to control and reduce CSOs are described. A major study of alternative methods of controlling CSOs in the West Point service area has been completed. Computer models were used to evaluate frequency and volumes of CSO under existing conditions to define baseline conditions, and to evaluate the effects of various CSO control alternatives in combination with the various secondary systems for existing and future conditions. Potential control measures include sewer separation; storage and treatment; at-site treatment; centralized treatment; and other methods. The advantages and disadvantages of each are discussed, along with the effects and costs of the CSO projects that can be used to achieve 75% CSO volume reduction. It was concluded that partial separation of about 9,000 acres of current combined area provides costs representative of what could be incurred to achieve one CSO event per year; these costs are estimated as $175 million. (Doria-PTT)
W89-04023

MILL EFFLUENT BREATHES EASIER WITH CARBON DIOXIDE,
Airco Industrial Gases, Murray Hill, NJ.
M. D. Matson.
Water Engineering and Management WENMD2, Vol. 135, No. 9, p 38, 41-42, September 1988.

Descriptors: *Pulp wastes, *Wastewater treatment, *Carbon dioxide, *Alkaline water, *Corrosion control, Scaling, Industrial wastes, Pulp and paper industry, Effluents, Calcium carbonate, Corrosion control, Hydrogen ion concentration, Sulfuric acid, Sumps, Bicarbonates, Carbonates, Safety, Mills, Industrial plants.

The use of acid to reduce the alkalinity of caustic pulp and paper mill effluent creates potential corrosion and safety problems. An alternative method is proposed for the treatment of highly alkaline wastewater that reduces pH levels and stabilizes corrosive mill effluent by the use of carbon dioxide. When CO2 is added to an aqueous stream, carbonic acid is formed, which reduces pH levels and permits them to be maintained within acceptable limits with great stability. The method is described as it is used by Simpson Paper Co., San Gabriel Mill, Pomona, CA. The use of CO2 at this mill has virtually eliminated the persistent calcium carbonate buildup, corrosion, and other problems experienced with an acid system. Effluent control costs have been reduced. The system is consistently maintaining pH within the narrow 7.5-8.0 range while controlling scaling in the sewer pipes. Employee reaction to the improved work environment has also been favorable. The trial unit is currently being replaced with a larger storage tank, two process vaporizers, and related equipment. The new system should provide enough gasified CO2 to meet extreme pH peaks more

efficiently and to allow for higher effluent flow rates in the future. (Doria-PTT)
W89-04024

DISPOSAL OF LEATHER TANNERY WASTES BY LAND TREATMENT: A REVIEW,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
For primary bibliographic entry see Field 5E.
W89-04213

CELLULOSIC ADSORBENTS FOR TREATING TEXTILE MILL EFFLUENTS,
Purdue Univ., Lafayette, IN. Lab. of Renewable Resources Engineering.
Y. Yang, C. M. Ladisch, and M. R. Ladisch.
Enzyme and Microbial Technology EMTED2, Vol. 10, p 632-636, October 1988. 2 fig, 3 tab, 21 ref.

Descriptors: *Wastewater treatment, *Cellulose, *Textile mill wastes, *Effluents, *Adsorbents, Dyes, Activated carbon, Color removal, Industrial wastes, Biological wastewater treatment.

The textile industry is one of the top ten water consuming industries with much being used in chemical treatment of textiles. Effluent treatment for pollution control is important due to the color and chemistry of the dyes and additives used during dyeing. Textile effluents vary in composition; numerous approaches have been developed for treatment of dyeing wastewater with several steps being combined to obtain effluent suitable for discharge. Activated carbons are used to treat textile wastewater because of their strong ability to adsorb by physisorption many of the dyes and chemicals found in dyeing solutions. Development of microbial degradation methods, which are broadly applicable, poses a challenge, since there were 9788 different generic names of colorants listed in the Color Index in 1982. Any single biological method can only be used for a limited number of these dyes. CM-cellulose and viscose have been used together with other adsorbents, such as activated carbons and nylons, for dye adsorption from textile mill wastewater. Cellulose fibers, after being treated in acidic chitin-containing solutions, are reported to have enhanced dye adsorption capacities that can exceed those of common activated carbons. The potential of using low-cost, renewable materials to adsorb low concentrations of dyes from wastewater has technical potential, particularly since the dye industry continues to develop structurally stable and highly fast dyes that readily adsorb on cellulose. Possible approaches for desorbing the dyes include using high temperatures, solvents, and different pH levels, although conditions must be defined so that degradation of the dye and/or adsorbent during desorption is minimized. (Davis-PTT)
W89-04315

ACTUAL SLUDGE PRODUCTION IN MUNICIPAL SECONDARY WASTEWATER TREATMENT PLANTS,
Kuwait Univ., Safat. Dept. of Civil Engineering.
M. F. Hamoda.
Environment International ENVIDV, Vol. 14, No. 1, p 29-35, 1988. 6 fig, 4 tab, 11 ref.

Descriptors: *Data collections, *Sludge, *Wastewater treatment, Suspended solids, Biochemical oxygen demand, Kuwait, Canada, Activated sludge solids, Nitrogen, Phosphorus, Anaerobic digestion.

Actual sludge production data is presented from 26 activated sludge treatment plants which were evaluated in an attempt to provide a better basis for design of sludge facilities. Sludge production data were collected from 25 operating activated sludge plants in Ontario, Canada, during a survey of municipal wastewater treatment facilities and from an activated sludge plant in Kuwait. The most important wastewater characteristics influencing sludge production rates are the suspended solids (SS) and the biochemical oxygen demand (BOD) concentrations or per capita figures. Ontario plants received medium-strength wastewater according to the classification of typical domestic wastewater composition. The high strength of Kuwait's wastewater is presumably due to the relatively low per capita water used and the established habits of community residents. The quantity and characteristics of sludge produced are related to the wastewater flow and characteristics, type of process, and degree of treatment. The two main sources of sludge generated at secondary (activated sludge) plants are SS from the influent wastewater (raw primary sludge) and biological solids synthesized from BOD removed in the activated sludge process (waste activated sludge). The average volume of sludge produced per volume of wastewater treated (about 0.5%) found in this study is similar to that typically reported, although a higher value (1%) is sometimes assumed in design. Waste (excess) activated sludge solids contribute significantly to the total sludge production in secondary wastewater treatment plants. In order to design sludge treatment and disposal facilities properly, not only the quantities of sludge solids are required, but also the characteristics of the sludge to be handled must be known. These characteristics vary depending on the origin of the sludge. (Davis-PTT) (Author's abstract)
W89-04316

SLUDGE CONDITIONING WITH MORINGA SEED,
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
J. O. Ademiluyi.
Environment International ENVIDV, Vol. 14, No. 1, p 59-63, 1988. 3 fig, 1 tab, 21 ref.

Descriptors: *Sludge drying, *Sludge conditioning, *Developing countries, *Filtration, *Wastewater treatment, *Niveria, Moringa seed, Sludge treatment, Sludge digestion.

The applicability of Moringa seed as a conditioning material during dewatering was evaluated. In all states of the Nigerian federation sanitation boards have been constituted for effective monitoring of environmental protection. Most wastewater treatment procedures, whether conventional or nonconventional, ultimately lead to the production of high water content sludge. The powdered seed of Moringa oleifera, a deciduous tree, has been found to improve sludge filterability. The seed compares favorably with the traditional ferric chloride conditioner. Cake and filtrate concentrations increase with increasing dosage of the Moringa seed during sludge filtration indicating that Moringa seed would be useful as a conditioner if the primary product of filtration is the procurement of high quality cake. It would not cost much to procure, since it can easily be grown. Moringa seed is a natural coagulant. The use of Moringa seed in sludge conditioning in wastewater treatment works or even in food processing industries where sludge filtration is expedient may not pose any serious problem because the fruit is edible. The optimum dosage for conditioning the digested sludge tested was 2.75 g/L. The chemical constitutents of the seed need to be identified so that any chemical content known to inhibit sludge filtration can be extracted. (Davis-PTT)
W89-04318

FULL-SCALE LAND TREATMENT OF COFFEE PROCESSING WASTEWATER,
Texas Univ. at Arlington. Dept. of Civil Engineering.
R. C. Loehr, W. W. Carey, A. Kull, and C. A. Swift.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1948-1952, November 1988. 2 fig, 6 tab, 4 ref.

Descriptors: *Food processing wastes, *Wastewater treatment, *Wastewater irrigation, *Water quality, *Land disposal, Wastewater disposal, Spray irrigation, Surface water, Pollutants, Wastewater facilities, Costs, Groundwater, Hydraulic conductivity, Geohydrologic boundaries.

A Sunbury, Ohio, coffee processing plant uses spray irrigation for the treatment and disposal of about 40 million gallons of wastewater each year. About 40.5 ha of a field that primarily consists of clover and reed canary grass are used in the application. Data from a four-year evaluation of the site are presented. The limiting factor for application capacity was the hydraulic capacity of the site, not the nitrogen or organic loading rates. High organic loadings and the applied wastewater were assimilated on the site and very little runoff occurred. The hydrogeologic conditions at the site limited vertical percolation of water contaminants. The operational cost of the system was about $0.528 per cubic meter of wastewater treated. (Author's abstract)
W89-04369

INHIBITION BY HAZARDOUS COMPOUNDS IN AN INTEGRATED OIL REFINERY,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Rebhun.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1953-1959, November 1988. 10 fig, 4 tab, 17 ref.

Descriptors: *Biological wastewater treatment, *Oil refineries, *Inhibition, *Wastewater treatment, *Hazardous materials, *Industrial wastes, Toxicity, Phenols, Degradation, Wastewater, Inhibitors, Sludge, Water quality, Activated carbon, Wastewater facilities, Flocculation, Activated sludge process, Pilot plants.

The biotreatability of refinery wastewater, the degradation of phenolic compounds, and their inhibitory effects were investigated in an on-site activated sludge pilot plant for three years. Process rates, kinetic constants, sludge yields and inhibition coefficients were derived from the analysis of experimental data. With average total phenols concentration from 13 mg/L to 50 mg/L, good treatment efficiencies could be achieved at specific BOD removal rates below 0.15 per day. Apparent saturation constant values were high and correlated directly with phenol concentrations, indicating their inhibitory effects. At the low specific loading rates phenol degraded efficiently. Strong phenolic waste discharges disrupted bioflocculation and the bioprocess. Separation, storage, and gradual controlled discharge of the strong wastes is indicated to prevent process disruption. The ability of activated carbon in activated sludge to reduce inhibition and increase process rates was studied. (Author's abstract)
W89-04370

CHARACTERISTICS OF RESIDUES FROM WET AIR OXIDATION OF ANAEROBIC SLUDGES,
Syracuse Univ., NY. Dept. of Civil Engineering.
A. A. Friedman, J. E. Smith, J. DeSantis, T. Ptak, and R. C. Ganley.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1971-1978, November 1988. 9 fig, 5 tab, 32 ref.

Descriptors: *Wastewater treatment, *Sludge drying, *Sludge, *Anaerobic conditions, *Wet oxidation process, Municipal wastes, Heavy metals, Dewatering, Sludge thickening, Water pollution control, Environmental effects, Temperature, Biodegradation, Chemical oxygen demand, Volatile solids.

This study evaluated the wet air oxidation (WAO) of anaerobic municipal sludges and the anaerobic treatability of WAO product liquors. The study showed that WAO, followed by dewatering of residual solids, reduced the volume of anaerobic sludges by greater than 96%. Reactor temperatures above 250 C generated microbial conditions that inhibited anaerobic treatment of soluble products. The optimum WAO operating temperature was 230 C where 65.5% of the volatile suspended solids was destroyed and about 60% of the soluble chemical oxygen demand (SCOD) generated was biodegradable. Anaerobic rotating biological contracts proved effective for removing biodegradable SCOD from WAO liquors. Most the heavy metals for the raw sludge were concentrated in dewatered solids. Settled and dewatered WAO volatile solids had much higher COD contents than raw anaero-

bic sludges, regardless of the operating temperature. (Author's abstract)
W89-04372

FEEDBACK CONTROL OF ACTIVATED SLUDGE WASTE RATE,
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil and Ocean Engineering.
D. A. Vaccari, A. Cooper, and C. Christodoulatos.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1979-1985, November 1988. 6 fig, 2 tab, 10 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Sludge, Flow, *Process control, *Flow rates, Simulation analysis, Sensors, Algorithms, Automation, Computer models, Biomass.

An algorithm for feedback control of activated sludge waste rate has been developed. It uses proportional-integral-derivative (PID) control with waste flow rate as the manipulated parameter and an unsteady-state calculation of sludge age as the process variable. PID control can be implemented either on-line using sensors and automatic control, or off-line using lab results and manual implementation of computed control action. Both methods were studied using computer simulation. Feedback control reduced the error is DSA by 60 percent for a step change in setpoint, and 80 percent for a step change in influent biochemical oxygen demand, as compared to no control. For a realistic forcing function consisting of six months of influent flow and BOD data, the variablity of the DSA was reduced by 22 percent by continuous PID control, and 14 percent by off-line control. Improved DSA control resulted in increased variability in system biomass. (Author's abstract)
W89-04373

BUBBLE-FREE AERATION USING MEMBRANES: PROCESS ANALYSIS,
P. Cote, J. Bersillon, A. Huyard, and G. Faup.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1986-1992, November 1988. 3 fig, 2 tab, 17 ref.

Descriptors: *Thin films, *Wastewater treatment, *Aeration, *Polymers, *Oxygenation, *Membrane processes, Oxygen transfer, Design criteria, Economic analysis, Mass transfer.

Thin synthetic polymer membranes can be used to transfer oxygen to a bioreactor without the production of bubbles. The mass transfer characteristics of a synthetic polymer membrane aeration systems are reviewed and design equations are presented. The design procedure is illustrated for oxygenation capacities typical of a conventional activated sludge system and of a high-rate membrane bioreactor. The specific membrane surface area and the specific aeration efficiency are calculated to be used as input in an economic analysis and to allow comparison with conventional aeration systems. (Author's abstract)
W89-04374

ABILITY OF AN ARTIFICIALLY ESTABLISHED WETLAND SYSTEM TO UPGRADE OXIDATION POND EFFLUENT TO MEET WATER QUALITY CRITERIA,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
T. J. Wrigley, and D. F. Toerien.
Water SA WASADV, Vol. 14, No. 4, p 171-177, October 1988. 7 fig, 7 tab, 54 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Filter crops, *Land treatment, *Wetlands, Water quality, Water quality standards, Effluents, Oxidation ponds, Suspended solids, Sedimentation, Coliforms, Grasses, Adsorption, Nitrification, Denitrification, Inorganic compounds, Phosphorus, Ammonia, Nitrates, Filtration, Organic matter.

A pilot scale artificially established wetland (AEWL) planted with Phragmites australis and referred to as a reed bed received effluent from an experimental oxidation pond system (OPS). Over a 12-month period, concentrations of inorganic phosphorus, ammonia, nitrate and total suspended solids (TSS) from the OPS were reduced by up to 70 percent; 50 percent of COD and all coliform bacteria were removed during passage through the AEWL. The water quality of the OPS effluent was upgraded to meet effluent standards of ammonia, TSS, E. coli and inorganic phosphorus after passage through the AEWL. The AEWL, a combination of gravel and soil, removed inorganic phosphorus from the OPS effluent, probably by the following mechanisms: P adsorption onto clay molecules; precipitation with calcium and iron; and uptake by microorganisms and Phragmites. Ammonia and nitrates were probably removed by nitrification/denitrification in aerobic and anaerobic zones, adsorption onto soil particles, and uptake by microorganisms and Phragmites. Organic matter was primarily removed by filtration and sedimentation. An extrapolated harvest of 71 tons per ha per annum could be expected from such systems and this crop could probably be used for fodder or building material. (Author's abstract)
W89-04388

FATTY ACID UTILISATION BY SLUDGE FROM FULL-SCALE NUTRIENT REMOVAL PLANTS, WITH SPECIAL REFERENCE TO THE ROLE OF NITRATE,
National Inst. for Water Research, Pretoria (South Africa).
E. S. Mostert, A. Gerber, and C. J. Van Riet.
Water SA WASADV, Vol. 14, No. 4, p 179-184, October 1988. 2 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Nitrates, *Sludge, *Nutrient removal, *Fatty acids, *Activated sludge, Phosphates, Organic compounds, Anaerobic conditions, Substrates, Calcium, Magnesium, Sulfates, Potassium, Denitrification.

The response of phosphate accumulating activated sludge, when exposed to various organic compounds under anaerobic and anoxic conditions is described. Batch experiments were used to study the interactions between phosphate release, substrate utilization and the concomitant concentration changes of ions such as calcium, magnesium, sulphate and potassium in sludge derived from four full-scale plants. The results obtained support the hypothesis that phosphate release occurs simultaneously with phosphate uptake under anoxic conditions. It is shown that substrate utilization is partitioned between the requirements associated with phosphate release and with denitrification respectively, and that the relative amounts depend on the nature of the substrate and the origin of the sludge. In situations where these substrate consuming reactions occur in parallel, up to 100% of propionate is expended on phosphate release. The corresponding value for acetate may be as low as 33% while with compounds such as lactate the substrate is utilized almost exclusively for denitrification rather than phosphate release. (Author's abstract)
W89-04389

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS: 1. MATHEMATICAL DESCRIPTION AND MODEL REPRESENTATION,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
A. E. Billing, and P. L. Dold.
Water SA WASADV, Vol. 14, No. 4, p 185-192, October 1988. 3 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Mathematical models, *Model studies, *Computers, *Simulation, *Growth kinetics, Numerical analysis, Biomass, Sludge, Aerobic conditions, Activated sludge process, Chemical reactions, Differential equations.

Biological growth applications may range from a laboratory fermentation for the production of a pharmaceutical compound to the treatment of municipal wastewater in a full-scale activated sludge process. A comprehensive mathematical model for the simulation of biological system behavior must account for a large number of reactions between a large number of components. A matrix format provides a useful method for model presentation. The matrix ensures clarity as to the compounds, processes, reaction terms and stoichiometry comprising the model. It allows ready comparison of different models and facilitates incorporating the model in a computer simulation program. The first step in setting up the matrix is to identify the compounds of relevance in the model. The second step is to identify the biological processes occurring in the system. A biological model of limited complexity was selected as a 'demonstration' model. The model incorporates only those features which relate to the utilization of carbonaceous material in an aerobic activated sludge system. For the steady-state situation, where the system operates under conditions of constant influent flow and load, the derivative terms in the reactor mass-balance equations fall away. This reduces the single-reactor-plus-settler example problem to a set of eight simultaneous non-linear algebraic equations. In the dynamic situation, the problem remains one of solving the system of four non-linear ordinary differential equations and four algebraic equations. Solution procedures for solving the sets of simultaneous equations resulting from the steady-state and dynamic situations necessitate specific considerations for each. (See also W89-04391 thru W89-04392) (Stoehr-PTT)
W89-04390

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS: 2. MODELLING OF THE STEADY STATE CASE,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
A. E. Billing, and P. L. Dold.
Water SA WASADV, Vol. 14, No. 4, p 193-206, October 1988. 6 fig, 4 tab, 14 ref, append.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Model testing, *Mathematical models, *Model studies, *Growth kinetics, Simulation, Numerical analysis, Biomass, Sludge, Aerobic conditions, Computers, Mathematical equations, Comparison studies, Finite difference methods.

In a biological reaction system, 'steady state' conditions are defined as those where the system operates under conditions of constant input flow rate and load and where the operating conditions are held constant. For the steady state problem, a set of simultaneous non-linear algebraic equations must be solved. Representing the mass balance equations in a matrix format assists in the choice of suitable numerical solution procedures. Five widely used procedures are evaluated and compared in application to the types of flow sheet encountered in practice. The method of direct linearization, although performing relatively efficiently of these test cases, is not a suitable technique for general use in a simulation program. The methods of Wegstein and successive substitution, although simple and robust, are inappropriate due to their slow rates of convergence. The poor performance of Wegstein's method in comparison to that of successive substitution could perhaps be eliminated by applying Wegstein only at selected intervals. Broyden's method converges to a solution in comparatively few iterations. However, the method as implemented requires an excessive amount of computational effort per iteration. Of the methods evaluated, Newton's appears to be the most favorable. In addition, the use of a finite difference approximation to the Jacobian matrix renders it a generally suitable technique for the biological flow-sheeting systems under consideration. (See also W89-04390)
W89-04391

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS 3. MODELLING OF THE DYNAMIC CASE,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
A. E. Billing, and P. L. Dold.
Water SA WASADV, Vol. 14, No. 4, p 207-218, October 1988. 4 fig, 3 tab, 6 ref, appendix.

Descriptors: *Wastewater treatment, *Model studies, *Biological wastewater treatment, *Growth kinetics, *Dynamics, *Mathematical models, Model testing, Computers, Simulation, Numerical analysis, Differential equations.

The selection of an integration scheme appropriate for the dynamics of biological reaction systems is outlined. The dynamic problem involves solving a set of coupled ordinary differential equations. A multirate technique based on Gear's approach was developed. Partitioning of the system on the basis of the model alone can lead to inefficiencies in the implementation of the multirate technique. This is one of the few drawbacks of the method. In practice, partitioning on the basis of practical experience and by trial examination of the system was found to be the most flexible approach. A predicator-corrector method with only one application of the corrector was found to be particularly suited to the dynamics of the system. The steplength adjustment procedure proposed by Dahlquist and Jborck (1974) has been found to be appropriate. The method was found to be superior to Gear's method of steplength halving or doubling. (See also W89-04390 thru W89-04391) (Stoehr-PTT)
W89-04392

STUDY OF REACTION KINETICS FOR THE PYROLYSIS OF BIOGENIC SLUDGE,
Oldenburg Univ. (Germany, F.R.). Fachbereich 9 - Chemie.
For primary bibliographic entry see Field 5E.
W89-04397

ASSESSMENT OF EXCESS BIOLOGICAL PHOSPHORUS REMOVAL DURING ACTIVATED SLUDGE TREATMENT,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
S. Yeoman, M. Hunter, T. Stephenson, J. N. Lester, and R. Perry.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 637-646, July 1988. 4 fig, 2 tab, 59 ref.

Descriptors: *Activated sludge process, *Phosphorus removal, *Biological wastewater treatment, *Wastewater treatment, Water pollution control, Anaerobic conditions, Temperature effects.

Modified laboratory scale activated sludge units were designed and constructed specifically for excess biological phosphorus removal. Once the sludge units became operational, several modifications were executed to enhance the removal of phosphorus. These modifications included the improvement of anaerobic conditions, augmentations with acetate and Acinetobacter/Aeromonas species, and increases in sludge age and temperature. The major factor found to influence phosphorus removal was temperature; a 1 C increase resulted in a 2.6% increase in phosphorus removal in the 12-25 C temperature range. During periods of high removal experiments were undertaken to identify the mechanism involved. Phosphorus removal is dependent on some physiochemical process; it appears related to, but not totally dependent on, metabolic activity. (Brock-PTT)
W89-04399

EVALUATION OF SETTLEABILITY AND SEPARATION CHARACTERISTICS OF ACTIVATED SLUDGE BY A TURBIDITY METER-INCORPORATING SVI METER,
Meidensha Corp., Tokyo (Japan). Development Div.
T. Sekine, H. Tsugara, S. Urushibara, N. Furuya, and S. Matsui.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 647-654, July 1988. 7 fig, 5 ref.

Descriptors: *Activated sludge process, *Municipal wastewater, *Wastewater treatment, *Turbidity, SVI meter, Supernatant turbidity, Settleability, Separation.

A newly developed SVI analyzer that permits monitoring of variation in supernatant turbidity was tested at a municipal wastewater treatment facility, the investigation involved continuous batch-settling tests. As a result, changes in activated sludge characteristics could be evaluated by monitoring time-serial variations in supernatant turbidity and batch settling curves. In the case of filamentous bulking, the supernatant turbidity changed inversely to 30-minute settled volume (SV30) or SVI raised to a power of 2.4. It was verified that the SVI, ISV and supernatant turbidity were useful for status supervision of activated sludge and control indexes. (Author's abstract)
W89-04400

AMMONIA REMOVAL AND RECOVERY FROM UREA FERTILIZER PLANT WASTE,
Roorkee Univ. (India). Dept. of Civil Engineering.
V. K. Minocha, and A. V. S. Prabhakar Rao.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 655-664, July 1988. 5 fig, 20 ref.

Descriptors: *Fertilizers, *Wastewater treatment, *Ureas, *Ammonia removal, Ammonia, Phosphoric acid, Air stripping.

Air stripping is the most simple method of ammonia removal from fertilizer wastewaters. Studies were carried out for the removal and recovery of ammonia. With experimental data, a nomogram was generated relating the three controllable variables, namely wastewater flow rate, air flow rate and percentage ammonia removal. It was found that one liter of commercially available raw grade phosphoric acid was sufficient to absorb the ammonia stripped out from more than 275 liters of wastewater having an influent ammonia concentration of 2000 mg/L. (Author's abstract)
W89-04401

MICROFLORA IN THE COMBINED FACULTATIVE POND AND AERATED LAGOON SYSTEM AT A SEA-BASED SOLID WASTE DISPOSAL SITE,
Gifu Univ. (Japan). Dept. of Agricultural Chemistry.
For primary bibliographic entry see Field 5E.
W89-04402

EFFECTS OF PH, TEMPERATURE AND AGITATION SPEED ON SLUDGE ANAEROBIC HYDROLYSIS-ACIDIFICATION,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
C. Perot, M. Sergent, P. Richard, R. P. T. Luu, and N. Millot.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 741-752, August 1988. 7 fig, 5 tab, 18 ref, append.

Descriptors: *Activated sludge process, *Anaerobic digestion, *Biological wastewater treatment, *Sludge digestion, *Wastewater treatment, Hydrolysis-acidification, Methanogenesis, Hydrogen ion concentration, Temperature effects.

Anaerobic sludge digestion may be divided into two stages: hydrolysis-acidogenesis and methanogenesis. These phases may be separated to improve the efficiency of the digestion. The hydrolysis of sludge was studied in laboratory fermenters with the aim of improving volatile fatty acids production during the first phase. The influence of pH, temperature and agitation speed was studied. A mathematical approach to this problem was used by means of a statistical tool: methodology experimental research (MER). For a specific proglem, this experimental design gave results under a wide range of conditions with only a few tests. Fifteen experiments were carried out to study the influence of three parameters during biological hydrolysis of a mixed sludge sewage. The best running conditions for hydrolysis were pH = 6.8, temperature = 50 C and agitation speed = 545 rpm. (Brock-PTT)
W89-04405

METHANOGENIC POTENTIAL OF SUBSTRATE IN ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
Istituto di Ricerca sulle Acque, Bari (Italy).
A. Brunneti, F. Lore, and V. Lotito.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 753-762, August 1988. 5 fig, 7 tab, 9 ref.

Descriptors: *Wastewaater treatment, *Activated sludge process, *Sludge digestion, *Anaerobic digestion, *Biological wastewater treatment, Methanogenesis, Chemical oxygen demand, Volatile solids, Suspended solids.

A new procedure for evaluating sewage amenability to anaerobic digestion has been developed. This test can be run in a batch reactor without mixing and pH correction, using for subsequent tests the same biological seed sludge stored without any particular care. By utilizing as a seed the sludge digested in a previous test, the biological potential apparently improves. Results showed that for different kinds of sludge the specific biogas production (cu m biogas/kg volatile suspended solids (VSS)) is different. This means that VSS concentration is not a valid parameter for evaluating the methanogenic potential of substrate. A more valid parameter would be COD which is more representative of sludge composition. Application of the COD method for wastewaters is being investigated for sludges. (Brock-PTT)
W89-04406

SULPHATE REMOVAL IN ACIDOGENIC PHASE ANAEROBIC DIGESTION,
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
M. A. M. Reis, L. M. D. Goncalves, and M. J. T. Carrondo.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 775-784, August 1988. 4 fig, 2 tab, 23 ref.

Descriptors: *Activated sludge process, *Anaerobic digestion, *Biological wastewater treatment, *Wastewater treatment, *Food-processing wastes, *Sulfate removal, Sulfates, Acidogenic phase, Molasses, Hydrogen ion concentration, Fermentation, Distilleries.

The acidogenic phase of a 2-stage anaerobic digestion process using distillery molasses slops effluent with high sulfate concentrations (4.2-5.1 g/L) was investigated. Sulfate removal was studied at pH 5.4, 5.8, 6.2, 6.6 and in a stirred reactor (CSTR) and in an upflow-fixed film-fixed bed reactor operated at 22 h, 1.2 days retention time. The biological sulfate removal increased with pH and so did the acetic acid production from the fermentative and sulfate-reducing bacteria. For the same pH and hydraulic retention time more efficient sulfate removal was obtained in the fixed film reactor than in the CSTR. (Author's abstract)
W89-04407

TREATMENT OF BANANA STEM JUICE: METHANE AND EFFLUENT PURIFICATION,
Instituto Centroamericano de Investigacion y Tecnologia Industrial, Guatemala City.
J. F. Calzada, M. C. Arriola, C. Rolz, and J. Valladares.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 785-790, August 1988. 1 fig, 5 tab, 3 ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Anaerobic digestion, *Food-processing wastes, *Effluents, Banana stem juice, Methane production, Effluent purification, Water hyacinth, Algae.

The preparation of banana stems for retting requires a mechanical crushing, yielding a polluting juice. This juice was fed to methanogenic reactors in which reticulated polyurethane foam was used as support for bacteria. Biogas productivities ranged from 0.66 to 1.76 v/vd for loads of 3.5 to 10 kg/cu m. Volatile solids reductions (at hydraulic retention times of 3 and 2 days) ranged from 38 to 46%, while the COD (chemical oxygen demand) reductions were from 39 to 63%. The digestor effluent was further treated using algal or water hyacinth systems, with reductions up to 66% in 10

days and 95% in 45 days with the algae system. (Author's abstract)
W89-04408

BIOLOGICAL PHOSPHATE REMOVAL FROM WASTEWATER WITH OXYGEN OR NITRATE IN SEQUENCING BATCH REACTORS,
TAUW Infra Consult B.V., Deventer (Netherlands).
G. J. F. M. Vlekke, Y. Comeau, and W. K. Oldham.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 791-796, August 1988. 2 fig, 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Activated sludge process, *Anaerobic digestion, *Phosphorus removal, *Phosphates, Sequencing batch reactors, Oxygen, Nitrate.

The feasibility of using nitrate as the sole electron acceptor for biological removal from wastewater was tested. Two sequencing batch reactors, one with nitrate and the other one with air to supply oxygen, were used to develop two sets of acclimated biomass. It was possible to induce biological phosphate removal with nitrate alone, confirming the ability of denitrifying bacteria for this process. A preliminary comparison, however, suggested that nitrate may be less efficient than oxygen for phosphate uptake. (Author's abstract)
W89-04409

COUNTER ION EFFECT ON PHOSPHATE SORPTION,
Centre of Excellence in Physical Chemistry, Peshawar (Pakistan).
S. Mustafa, S. Y. Hussain, N. Rehana, and I. Haq.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 817-824, August 1988. 4 fig, 4 tab, 11 ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Anion exchange, *Water reuse, Phosphate sorption, Counter ion effect, Chemical analysis.

Phosphate sorption on the strong basic anion exchanger Amberlite IRA-400 as a function of the counter ion was studied. The sorption decreases in the order OH(-) > Cl(-) > Br(-) > I(-). Counter ion released/phosphate sorbed ratios indicate that at low concentrations the resin mostly prefers the doubly charged HPO4(2-). The data is explained with the help of a modified Langmuir and mass law action equations. (Author's abstract)
W89-04411

WETTED WALL ULTRAVIOLET PHOTOREACTOR FOR THE DISINFECTION OF LIQUIDS,
South Bank Polytechnic, London (England). Dept. of Chemical Engineering.
R. C. Ashton, E. G. Killick, G. Shama, and A. J. Smith.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 853-856, August 1988. 2 fig, 1 tab, 7 ref.

Descriptors: *Disinfection, *Wastewater treatment, Ultraviolet photoreactor, Turbidity, Mircoorganisms.

Construction details are given for an ultraviolet photoreactor designed specifically to disinfect liquids, particularly wastewaters, of high turbidity. The liquid to be disinfected flows vertically as a turbulent film concentrically to a tubular ultraviolet source. A particular advantage of this type of photoreactor is that the liquid does not foul the ultraviolet source as contact between the two does not occur. Preliminary results for the disinfection of a synethic wastewater at different flow rates through the photoreactor showed that as the volumetric flow rate increases, the mean time for UV exposure decreases. For a given reactor geometry, the uppermost limit on flow rate may be defined either by the liquid handling capacity of the equipment or the criterion wastewater. (Brock-PTT)
W89-04412

VOLATILIZATION OF WASTEWATER TRACE ORGANICS IN SLOW RATE LAND TREATMENT SYSTEMS,
Yeungnam Univ., Gyongsan (Republic of Korea). Dept. of Environmental Engineering.
K. S. Park, D. L. Sorensen, J. L. Sims, and V. D. Adams.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 3, p 219-229, Summer 1988. 2 fig, 5 tab, 17 ref.

Descriptors: *Wastewater treatment, *Land treatment, *Organic compounds, *Land disposal, Toxicity, Volatilization, Slow rate land treatment systems, Halogenated hydrocarbons, Chlorinated hydrocarbons.

Volatilization of selected toxic volatile organic compounds (VOCs) in slow rate land treatment (SR) systems was studied in laboratory soil columns. Chloroform, 1,1,1-trichloroethane, trichloroethylene, and 1,2-dichlorobenzene volatilized 29 to 55%; carbon tetrachloride, dichlorobromomethane, dibromochloromethane, tetrachloroethylene, and 1,3-dichlorobenzene to a lesser extent (15-30%); and bromoform volatilized less than 10%. The soil reduced volatilization losses by 10- to 100-fold compared with theoretical volatilization from water. The soil type and VOC concentration did not affect volatilization, but volatilization increased with temperature. (Author's abstract)
W89-04415

FILAMENTOUS BULKING IN NUTRIENT REMOVAL ACTIVATED SLUDGE SYSTEMS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Wanner, and P. Grau.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 1-8, 1988. 2 fig, 1 tab, 26 ref.

Descriptors: *Bulking sludge, *Nutrient removal, *Activated sludge process, *Microorganisms, Anaerobic conditions, Fermentation, Oxygen requirements, Selective media, Bacteria, Substrates, Nitrogen, Hydrolysis.

The behavior of filamentous microorganisms under anaerobic, anoxic, and oxic conditions was reviewed. A continual changing of environmental conditions is characteristic of nutrient-removal activated-sludge systems and leads to a selective pressure. The following types of microorganisms can survive in the biocenosis of activated sludge: (1) Fermentative and polyphosphate-accumulating bacteria which utilize organic substrate under anaerobic conditions; (2) microorganisms capable of utilizing oxidized nitrogen as a final electron acceptor in their electron transport system; and (3) microorganisms growing under low substrate concentrations in oxic zones. It was concluded that the growth of most filamentous microorganisms is suppressed under anaerobic and anoxic conditions. Filamentous bulking in nutrient removal systems is therefore chiefly caused by the growth of filamentous microorganisms in oxic zones. Both remaining original soluble substrate and the soluble substrate released by hydrolysis of particulate substrate enmeshed in activated sludge flocs serve as an electron source in oxic zones. The problems with filamentous bulking in nutrient-removal systems may be considerably reduced by compartmentalization of all zones. The oxic zone should be compartmentalized in any case. (Author's abstract)
W89-04444

EXPERIENCE WITH A SELECTOR USED FOR TREATMENT OF SUGAR BEET WASTE,
Sugana Zucker G.m.b.H., Vienna (Austria).
E. Ruider, H. Kroiss, and W. von der Emde.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 9-21, 1988. 11 fig, 4 tab, 12 ref.

Descriptors: *Wastewater treatment, *Bulking sludge, *Food-processing wastes, *Selectors, *Activated sludge process, Sugar crops, Beets, Pilot plants, Selective media, Aeration, Sludge volume index, Shock loads, Costs, Austria.

It was necessary to find the most reliable and economic solution for the wastewater problems of the largest sugar mill in Austria. Due to the local situation (small receiving water--100-200 l/s, rural area) and the wastewater volume (up to 45,000 cubic m/d) of this factory a low-loaded activated-sludge plant treating this low-concentration wastewater turned out to be optimal. The major challenge was to avoid sludge bulking by filamentous organisms. Pilot investigations showed that the installation of a selector with a volume of 2.5% of the aeration tank in combination with nutrient addition resulted in a stable and low sludge-volume index. During the startup phase there was a certain growth of filamentous bacteria; selection was started when the substrate became a limiting factor and excess sludge withdrawal began. The results of the pilot investigations were the basis for the design of the full-scale plant. The installed plant consists of a 6700-cubic-m-capacity primary-sedimentation tank, a 400-cubic-m selector (coarse-bubble-aeration tank), a main aeration tank of 16,000-cubic-m capacity equipped with 16 mammoth rotors each 9 m long, and a final settling tank. The plant has now been in operation for three years and has provided low effluent concentration, high removal efficiency, reliable and simple operation, the capacity to absorb shock loads, and startup within 3-4 days. The treated effluent will be recirculated to the factory to reduce groundwater consumption and wastewater discharge. (Shidler-PTT)
W89-04445

OPTIMIZING NITRIFICATION IN AERATION BASINS WITH SURFACE AERATORS,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
W. Maier, and K. Krauth.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 23-28, 1988. 6 fig, 1 tab.

Descriptors: *Wastewater treatment, *Nitrification, *Aeration, *Aerators, *Aeration lagoons, Dissolved oxygen, Oxygen requirements, Compressed air, Activated sludge, Absorption.

Examination of the operation data of 23 activated-sludge plants showed that surface aerators did not nitrify as well as diffused air. Investigations revealed that the oxygen supply to the sludge limited the nitrification in the depths of the tanks. For an oxygen supply from a single source, such as a surface aerator, the activated sludge has to be provided with a relatively high concentration of oxygen in order to allow for uptake during the time that the sludge is in the deeper regions of the basin. In comparison with the plants using surface aerators, the plants with compressed air systems had higher nitrification rates at comparable oxygen concentrations as measured at the surface of the aeration basins. To overcome this, it is necessary to operate surface aeration plants with a higher dissolved-oxygen concentration. The results showed that 2.5 mg/L of oxygen at the surface was necessary, whereas for diffused-air plants 1.5 mg/L over the whole tank surface was adequate. (Shidler-PTT)
W89-04446

AMMONIA CONTROLLED ACTIVATED SLUDGE PROCESS FOR NITRIFICATION-DENITRIFICATION,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
P. J. Spies, and C. F. Seyfried.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 29-36, 1988. 5 fig, 1 tab, 8 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Activated sludge process, *Nitrification, *Denitrification, *Ammonia, *Nitrogen, Oxidation, Nutrient removal, Effluents, Water quality standards, Wastewater facilities, *Aeration, Optimization, Process control, Tourism, Food-processing wastes.

The sewage-treatment plant of the city of Husum (110,000 Population Equivalents) is subject to very large load variations due to tourism, industry

(mainly a slaughterhouse), and trade. The effluent is discharged into the tidal harbor area. The ammonia-nitrogen standard has been fixed at a maximum of 5 mg/L at 15 C water temperature or above. The installed plant has proved to meet this standard safely. The biological stage consists of an aeration plant with simultaneous nitrification/denitrification. The oxygen input of the plant is controlled by ammonia measurement inside the aeration tank. The ammonia control is supplemented by an oxygen-control sensor to eliminate superfluous oxygen input in borderline cases. This design allows the full exploitation of the denitrification capacity in the plant as well as the required decrease in nitrification. Since in winter the load on the plant is reduced by about 50%, almost full nitrification was retained even at a water temperature of 3.5 C in the aeration tank. The ammonia-nitrogen concentration in the effluent at no time exceeded a value of 4.0 mg/L. At low-load times it was first found that the rotors transferred too much oxygen into the aeration tank so that no denitrification occurred. After optimizing the control logic, extensive denitrification, down to nitrate-nitrogen values of 2 mg/L in the effluent, was achieved. (Shidler-PTT)
W89-04447

MICROSCOPIC EVALUATION OF CARBON AND PHOSPHORUS ACCUMULATION IN NUTRIENT REMOVAL ACTIVATED SLUDGE PLANTS,
Johannesburg City Health Dept. Labs. (South Africa).
L. H. Lotter, and M. Murphy.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 37-49, 1988. 30 fig, 23 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Nutrient removal, *Carbon, *Phosphorus, *Microscopic analysis, Phosphorus removal, Flocculation, Biomass, Slime, South Africa.

Successful phosphorus removal by an activated-sludge plant depends ultimately on the ability of the biomass to store carbon in the form of polyhydroxybutyrate and phosphate as polyphosphate. The microscopic evaluation of phosphate-removal plants--Bushkoppie Sewage Purification Works, Goudkoppies Works, and Northern Works Modules 2 and 3 (Johannesburg, South Africa)--during startup is described. Floc-forming cells in the aerobic zone of an efficient phosphorus-removing plant contained large polyphosphate inclusions, and were usually larger in size than anaerobic-zone cells. In a new activated-sludge plant, monitoring the development of biomass (after seeding with mixed liquor from the Goudkoppies Works) demonstrated the rapid formation of a typical activated-sludge floc. The distinct differences between polyhydroxybutyrate and polyphosphate storage in the anaerobic, anoxic, and aerobic zones observed in Goudkoppies sludge were, however, not evident in the new plant until two weeks after startup; the large clusters of polyphosphate-containing bacteria observed in phosphorus-removing plants were considered contingent on the production of extracellular slime. This was borne out by the examination of various plants for the presence of extracellular slime, revealing that the presence of this material correlates well with satisfactory phosphorus removal. (See also W89-04449) (Author's abstract)
W89-04448

OPERATING EXPERIENCE WITH BIOLOGICAL NUTRIENT REMOVAL AT THE JOHANNESBURG BUSHKOPPIE WORKS,
Johannesburg City Engineer's Dept. (South Africa).
A. R. Pitman, B. C. Trim, and L. van Dalsen.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 51-62, 1988. 3 fig, 6 tab, 10 ref, append.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Nutrient removal, *Wastewater facilities, *Activated sludge, *Denitrification, Phosphorus removal, Substrates, Chemical oxygen demand, Fatty acids, Anaerobic bacteria, Aeration, Scum, South Africa.

Operating experience at Bushkoppie, as with the other biological nutrient-removal plants in Johannesburg, has shown that this process can produce consistently good results (i.e., total N less than 10 mg/L and total P less than 1.0 mg/L) provided certain basic requirements are met. The quality of the substrate fed to the biological nutrient-removal process is of overriding importance. Sewages containing significant quantities of readily-biodegradable COD, in particular, short-chain volatile fatty acids, promote high denitrification rates and stimulate the growth of bacteria such as Acinetobacter which accumulate excess quantities of phosphate. Once the necessary substrate has been produced, it must be made available to phosphate-accumulating bacteria in the anaerobic zone without competition from other organisms. For this reason, nitrate and oxygen inputs to the anaerobic zone should be avoided. Aeration should be such that ammonia is just completely oxidized by the end of the main anaerobic zone, with overaeration above this point being avoided, as it can produce unnecessary further nitrification and aerobic phosphate release. The proliferation of nuisance scums can be avoided by ensuring a free surface passage through the complete activated-sludge reactor. Waste sludge handling and treatment must be such that phosphorus-rich side streams do not overload the phosphate-removal capacity of the main process. (See also W89-04448) (Shidler-PTT)
W89-04449

START-UP AND RUNNING-IN OF THE SOREQ BIOLOGICAL WASTEWATER TREATMENT PLANT,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
Y. Gruber, D. Farchill, G. Arueste, and M. Goldstein.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 63-75, 1988. 5 fig, 2 tab, 7 ref.

Descriptors: *Wastewater facilities, *Biological wastewater treatment, *Testing procedures, *Process control, *Project planning, Computers, Aerators, Clarifiers, Israel.

The Soreq biological wastewater-treatment plant was recently brought into operation after the completion of a comprehensive preliminary testing program. The facilities--including preliminary treatment, two large biological reactors (each equipped with thirty-six horizontal rotor/aerator units), and five clarifiers of fifty-two meters diameter--are operated through a distributed automation and control system of programmable controllers and a man/machine interface based on multiple industrial microcomputers. The following general conclusions may be drawn from experience at the Soreq treatment plant: (1) The investment in preparatory activities, such as testing with clear water and personnel training, has proved to be most effective in expediting the startup sequences and minimizing mechanical and process failures when running in with wastewater; (2) the planning and management of startup activities through the 'Operations Coordinating Committee' resulted in an efficient and smooth transition from simulated operation with clear water to full-scale running in of the plant with wastewater; and (3) the direct participation and supervision by the design consultant's 'Running-in Team', throughout all stages of the plant's startup and running-in sequences, fully utilizes the knowledge and experience of the design personnel, and ensures the maximum performance of the facilities. (See also W89-04451) (Shidler-PTT)
W89-04450

OXYGEN TRANSFER MEASUREMENTS AND AIR DISTRIBUTION FOR AN AERATION BASIN WITH FINE BUBBLE DIFFUSERS,
Milwaukee Metropolitan Sewerage District, WI. Treatment Services Div.
R. Warriner.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 77-84, 1988. 4 fig, 4 tab, 6 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Oxygen transfer, *Air circulation, *Aerators, *Efficiency, Diffusers, Dissolved oxygen, Oxygen uptake, Activated sludge, Off-gas, Design criteria.

The off-gas method was used to study oxygen transfer efficiency in a long narrow activated-sludge basin. The basin was equipped with square ceramic fine-pore diffuser plates arranged in a uniform longitudinal pattern at a depth of 4.3 m. Oxygen-transfer efficiency during the second and third years following diffuser cleaning was between 15 and 17%, at 20 C and zero dissolved-oxygen concentration. A uniform distribution of air to the tank was compared with a tapered air supply (more air at the inlet end and less at the outlet). The tapered air supply gave lower dissolved oxygen at the outlet and did not increase overall oxygen transfer. With a 3-fold to 5-fold variation in air flow at either the inlet or outlet zone of the basin, the oxygen transfer efficiency, adjusted for zero dissolved oxygen, stayed constant. (See also W89-04450) (Author's abstract)
W89-04451

EVALUATION OF THE EFFICIENCY OF A NEW AERATION SYSTEM AT HENRIKSDAL SEWAGE TREATMENT PLANT,
Stockholm Water and Wastewater Works (Sweden).
L.-G. Reinius, and J. Hultgren.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 85-92, 1988. 6 fig, 1 tab.

Descriptors: *Wastewater facilities, *Activated sludge process, *Aerators, *Oxygenation, *Efficiency, Respiration, Air circulation, Oxygen transfer, Mass transfer, Nitrification, Diffusers, Clogging, Sensors, Computers, Data acquisition, Sweden.

Henriksdal sewage-treatment plant is the largest plant in Stockholm with a design flow of 370,000 cubic m/d. In one of the eleven aeration tanks a new fine-bubble aeration system has been in operation since August 1985. Instruments installed include separate airflow monitors in each of the five zones and DO probes in the inlet and outlet of the zones. The instruments are connected to a computer for data acquisition. To evaluate the efficiency of the aeration system the oxygenation-transfer capacity was calculated from the oxygen mass-balance equation for each zone as a function of airflow. When the overall mass-transfer coefficients (at process conditions) are known as functions of the airflow the mass-balance equation can be used to calculate the respiration rate in each zone. The computer has been logging data for 22 months, and it is possible to calculate hourly respiration rates in the different zones throughout this period. It is very important to know the respiration along the tank and how it varies in order to get the optimal tapering of the diffusers when it is time to change the aeration system in the other 10 tanks. Over the year, the calculations show a different pattern in the respiration; this pattern depends on the rate of nitrification. Another use of the calculation of the oxygenation-transfer efficiency is to recognize whether any long-term change occurs due to clogging of the diffusers. (Author's abstract)
W89-04452

DISSOLVED OXYGEN CONTROL IN THE ACTIVATED SLUDGE PROCESS,
Meiring and Partners, Pretoria (South Africa).
J. L. Barnard, and P. G. J. Meiring.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 93-100, 1988. 6 fig, 1 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Dissolved oxygen, *Aerators, *Process control, *Efficiency, Air circulation, Nutrient removal, Respiration, Water quality standards, Automation, Sensors, Pumps, Energy costs.

The increased cost of energy and the need for biological removal of nutrients has resulted in renewed interest in dissolved-oxygen control in the activated-sludge process. The performance of nutrient-removal plants depends largely on the effectiveness and reliability of the DO-control equipment, especially where low levels are required for both nitrogen and phosphate in the effluent. In fine-bubble diffused-air aeration-system (FBDAAS) plants with multiple basins and a cen-

tral blower house, the proper division of the airflow to the various modules has presented problems. Monitoring of the airflows and secondary loops for balancing the airflow to each module after each change in airflow proved to be the best method of ensuring the correct airflow to each module. The best position for the probes in FBDAAS plants or surface-aeration plants having formal anoxic zones with mixed-liquor recycle pumps is just ahead of the pumps. For 'combined' anoxic/aeration plants with a combined reactor, the best position was found to be between the last two aerators. Channel systems present a problem in that the variations in DO are too small and one must resort to control systems using respiration techniques. Proper backup systems are necessary for nutrient-removal plants; these may consist of timer switches for surface-aeration plants or digital or analog signals representing the diurnal oxygen demand, supplanting the DO-derived signal during failure of the control system. (Shidler-PTT)
W89-04453

IMPROVED OXYGEN DISSOLUTION CONTROL FOR OXYGEN ACTIVATED SLUDGE,
Arkansas State Univ., State University. Dept. of Engineering.
R. C. Clifft, and M. T. Garrett.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 101-108, 1988. 3 fig, 3 tab, 6 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Dissolved oxygen, *Process control, *Efficiency, Design flow, Design criteria, Vacuum-exhaust control, Simulation analysis, Cost analysis, Wastewater facilities, Houston, Texas.

Now that oxygen-production facilities can be controlled to match the requirements of the dissolution system, improved oxygen-dissolution control can result in significant cost savings for oxygen-activated sludge plants. The potential cost savings of the vacuum-exhaust control (VEC) strategy for the city of Houston, Texas, 69th Street Treatment Complex is examined. VEC involves operating a closed-tank reactor slightly below atmospheric pressure and using an exhaust apparatus to remove gas from the last stage of the reactor. Computer simulations for one carbonaceous reactor at the 69th Street Complex are presented for the VEC and conventional control strategies. At 80% of design loading VEC was found to provide an oxygen-utilization efficiency of 94.9% as compared to 77.0% for the conventional control method. At design capacity the oxygen-utilization efficiencies for VEC and conventional control were found to be 92.3% and 79.5%. Based on the expected turndown capability of Houston's oxygen production facilities, the simulations indicate that the VEC strategy will more than double the possible cost savings of the conventional control method. Additional savings at 80% and 100% of design loading are estimated to be $113,000 and $46,500 per year for the VEC strategy. (Author's abstract)
W89-04454

PERFORMANCE ANALYSIS OF THE AERATION TANKS IN THE ACTIVATED SLUDGE SYSTEM,
Kobe Univ. (Japan). Dept. of Civil Engineering.
Y. Iida.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 109-120, 1988. 7 fig, 2 tab, 8 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Aerators, *Efficiency, *Tracers, Performance evaluation, Substrates, Fluid flow, Flow pattern, Mixing, Load distribution, Oxygen demand, Mathematical models, Mathematical equations.

The performance of large-scale aeration tanks from the viewpoints of substrate behavior and characteristics of fluid flow was evaluated. The results of tracer studies applied to mathematical models indicated that flow was subject to high longitudinal and latitudinal dispersion in the aeration tanks. However, the flow patterns were too complicated to describe satisfactorily with the mathematical models; a key problem lay in trying to join a transient system to an equilibrium model. In the light of the transient nature of physical, chemical, and biological factors controlling the mechanism of the activated-sludge process, a unified kinetics model would seem most unlikely. As regards load distribution, the empirical equation C/C sub 0 = u/(u + Kx) well described the BOD distribution in the aeration tanks whatever the flow characteristics and tank geometry. In this equation C = the exit concentration of tracer at time t, C sub 0 = the mass of tracer divided by nominal tank volume, u = flow velocity, and x = distance. The equation is definitely valid in field installations operating under conventional conditions. The activated-sludge system is so complex, a detailed examination of a few sets of data can be of more practical value than trying to fit observed data to sophisticated models which may attempt to be over-precise. (Author's abstract)
W89-04455

OPTIMISATION AND UPRATING OF ACTIVATED SLUDGE PLANTS BY EFFICIENT PROCESS DESIGN,
Water Research Centre, Stevenage (England).
B. Chambers, and G. L. Jones.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 121-132, 1988. 3 fig, 1 tab, 25 ref.

Descriptors: *Wastewater facilities, *Activated sludge process, *Model studies, *Optimization, *Efficiency, Oxygen demand, Oxygen nitrates, Kinetics, Aerators, Computer programs, Design criteria, Plug flow, Water quality.

The WRc Activated Sludge Model has been developed over a number of years and is based on the concept of describing the kinetics of BOD removal by including a Monod term for growth and a Michaelis/Menten term for enzymatic activity. Since the first formulation of the model, further equations have been added which describe the use of oxygen and nitrate as electron acceptors for the conversion of BOD. The model equations can be used to predict the performance of most configurations of the activated-sludge process by using the 'tanks in series' concept to describe aeration-tank mixing characteristics. Solutions to the equations are easily obtained by standard numerical-integration techniques using a computer. The software has been written in such a way that the model can be used interactively by a plant designer. Results obtained using the mathematical model have been used to redesign several full-scale activated-sludge plants in the UK. In some cases, it has been possible to reduce the energy costs for aeration by 40% while maintaining effluent quality by accurately matching the supply of oxygen to the spatially-varying oxygen demand in plug-flow aeration tanks. Bulking-sludge problems have also been solved by the conversion of completely-mixed aeration tanks to plug-flow aeration tanks with complementary redesign of the aeration system. (Author's abstract)
W89-04456

INVESTIGATIONS OF SECONDARY SETTLING AT A LARGE TREATMENT PLANT,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
D. J. Lumley, P. Balmer, and J. Adamsson.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 133-142, 1988. 6 fig, 3 tab, 14 ref. Swedish Board for Technical Development contract 84-4448.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Wastewater facilities, *Activated sludge, *Sedimentation, *Effluents, Water quality standards, Average flow, Peak flow, Suspended solids, Polymers, Settling tanks, Sensors.

The sedimentation phase of the activated-sludge process has a large influence on the effluent quality of secondary wastewater-treatment plants. Increasingly-stringent effluent guidelines emphasize the need to improve the performance of secondary settlers. Full-scale studies of rectangular settlers were made at a secondary-treatment plant with an average flow of 4 cubic m/s. The non-settleable fraction of the effluent suspended solids defines an upper limit to settler efficiency. Polymer can be used to enhance settling when dealing with peak flow situations. The mass of solids in the settler, needed to calculate a mass balance of the activated-sludge process, can be estimated by a simple model based on the sludge-blanket depth and the average concentration of the sludge blanket at a central location in a settler. Online instruments are useful for monitoring rapid and periodic changes in the state of the activated-sludge process. (Author's abstract)
W89-04457

INFLUENCE OF THE DEPTH OF THE SECONDARY SEDIMENTATION TANKS ON THE SEDIMENTATION EFFICIENCY AT BROMMA SEWAGE TREATMENT PLANK,
Stockholm Water and Wastewater Works (Sweden).
M. Tendaj-Xavier, and J. Hultgren.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 143-152, 1988. 4 fig, 1 tab.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Sedimentation, *Settling tanks, *Design criteria, *Efficiency, Chemical precipitation, Biological wastewater treatment, Activated sludge, Nitrification, Denitrification, Suspended solids, Water quality standards, Ammonium, Design flow, Sweden.

Bromma sewage-treatment plant is the second-largest plant in Stockholm with a design flow of 160,000 cubic m/d. The wastewater is treated mechanically, chemically by pre-precipitation with ferrous sulfate, and biologically by the activated-sludge process. The requirements for the plant are 8 mg BOD sub 7/L, 0.4 mg P/L, and 2 mg ammonium N/L. The ammonium requirement is for the period July-October. In order to meet these rather stringent requirements, the biological step was expanded 3 years ago with 6 new sedimentation tanks. The 6 new tanks have the same area as the 6 old ones, but they have a depth of only 3.7 m compared with the depth of the old tanks, 5.7 m. Experience from the first years of operation of the new secondary-sedimentation tanks is that they are more sensitive and less efficient than the older ones. It seems that the effluent suspended-solids concentration from the old tanks is less influenced by rapid flow variations than that from the new ones. During the nitrification period, denitrification takes place to some degree in the sedimentation tanks. This may cause loss of solids and it has been observed that the deeper old tanks usually produce an effluent of better quality and seem to be less influenced by denitrification than the new ones. (Author's abstract)
W89-04458

EFFECT OF ACTIVATED SLUDGE PROCESSES ON SECONDARY SETTLING TANK EFFICIENCIES,
Ceske Vysoke Uceni Technicke v Praze.
Z. Konicek, and J. Burdych.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 153-163, 1988. 3 fig, 4 tab, 26 ref.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Activated sludge process, *Settling tanks, *Aeration, *Performance evaluation, Comparison studies, Wastewater facilities, Particulate matter, Flow pattern, Turbulent flow, Density currents, Design criteria, Efficiency.

To show the complexity of the problems connected with the activated-sludge separation efficiency in sewage treatment plants, studies were conducted in 18 plants where various aeration methods and different types of secondary settling tanks are used. As measured by the number of particles in the secondary settling-tank effluent, efficiency was affected by the parameters of the aeration process as well as by the sludge-loading and solids-retention time of the activated sludge. Turbulence conditions in the aeration tanks and flow patterns in the secondary settling tanks were of great importance. In diffused-air aeration the degree of particle disintegration was relatively low and mechanical aeration, with horizontal or vertical rotors, was somewhat worse in this respect. Of the secondary set-

tling-tank types, the vertical-flow and circular-with-radial-flow tanks were the most efficient. Of the rectangular types, those with transverse horizontal flow showed better flow patterns than those with longitudinal horizontal flow. To ensure favorable flow patterns and a higher separation efficiency, deep inlets near the bottom of the secondary settling tanks were essential. The density current occurring along the bottom of the tank had the advantage that it decreased the number of activated-sludge particles smaller than 60 microns in the secondary settling-tank effluent. (Author's abstract)
W89-04459

INFLUENCE OF BLADE HEIGHT ON THE REMOVAL OF SLUDGE FROM ACTIVATED SLUDGE SETTLING TANKS,
Fachhochschule Koeln (Germany, F.R.).
E. Billmeier.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 165-175, 1988. 7 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Activated sludge process, *Settling tanks, *Storm wastewater, *Design criteria, Wastewater facilities, Water quality, Mixed liquor solids, Sludge thickening, Sludge solids, Sedimentation.

The quality of effluent from activated-sludge plants depends on the efficiency of the final settling tanks, which should be designed to handle the sludge load in storm-flow conditions. Because of the importance of continuous sludge removal final settling tanks with horizontal flow have to fulfill the functions of thickening and collection of sludge. The solids in the removed sludge need to flow freely to the return sludge draw-off. In circular tanks with rotating scraper arms this will be achieved only by installing the correct blade height. The calculation depends on many final settling operational parameters. Most of the existing blades in circular tanks are too small, so that many treatment plants work inefficiently. Such disadvantages can be eliminated by simple measures such as blade enlargement, raising the rotational velocity, or lengthening the existing arms. (Author's abstract)
W89-04460

USE OF SUBMERGED BIOLOGICAL FILTERS FOR NITRIFICATION,
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
S. Schlegel.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 177-187, 1988. 7 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Advanced wastewater treatment, *Biofiltration, *Subsurface filters, *Aeration, *Nitrification, Activated sludge process, Protozoa, Bacteria, Oxygen demand, Kjeldahl procedure, Denitrification, Biological degradation, Trickling filters, Effluents, Suspended solids, Settling tanks, Clogging, Performance evaluation, Installation.

Trials using submerged biological filters, made of molded polyethylene and aerated by compressed air, are described. The tests included operation as a submerged biological filter with sludge recycle, or activated-sludge process with submerged biological filter (configuration A); as a single-stage submerged biological-filter installation (configuration B); and as a secondary submerged biological-filter stage (configuration C). In configuration A the filter is populated mainly by protozoa. The use of the filter is therefore mainly to eliminate solids (bacteria) by protozoa. When the hydraulic conditions are insufficient, there is a risk of clogging. In configuration B, BOD and Kjeldahl-nitrogen reduction take place successively. The installation is relatively simple to operate. The same also applies to configuration C; this is used for nitrification purposes. Extensive BOD elimination is advisable in the upstream activated-sludge or trickling-filter stage. Denitrification is not possible. As a result of biological degradation, the effluent from all submerged biological-filter installations contains suspended solids which have to be separated to achieve low BOD and COD concentrations. This can take place in a settling tank. Filtration can also be a practical method. Separation of solids can be dispensed with if a downstream polishing pond is installed. (Shidler-PTT)
W89-04461

ANAEROBIC-AEROBIC TREATMENT OF INDUSTRIAL WASTEWATER,
Ruhrverband, Essen (Germany, F.R.).
H. Bode.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 189-198, 1988. 8 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, *Aerobic treatment, *Industrial wastewater, *Ammonia, Nitrogen, Combined treatment, Food-processing wastes, Effluents, Water quality, Economic aspects, Design criteria, Wastewater facilities, Performance evaluation, Pectin processing, Beet-sugar processing, Animal-byproducts processing.

A combined anaerobic/aerobic, and a solely aerobic, treatment of some food-processing wastewaters were compared. Wastewaters from pectin production, beet-sugar manufacture, and an animal-pulp factory (in which byproducts from poultry slaughterhouses are processed) were treated in two experimental process lines. One line consisted of anaerobic treatment prior to aerobic treatment; in the other, only aerobic treatment was applied. Aerobic treatment alone yielded slightly-better final effluent concentrations for sugar and pectin wastewater; the differences were, however, so minor that they can be neglected in deciding between treatment systems. It is well-known that anaerobic treatment operates with extreme energy economy and that less sludge is produced in the combined system compared to a solely aerobic treatment. In the case of the animal-pulp wastewater anaerobic/aerobic treatment cannot be recommended. The selective elimination of carbonaceous compounds in the anaerobic process leaves behind much higher loads of ammonium nitrogen than in a solely aerobic process. This causes severe operational problems. The experiments with the pectin wastewater led to the design of a full-scale treatment process. This plant has been in operation for several months now. The results of the treatment are satisfactory. They are very similar to those found in the experimental work. (Shidler-PTT)
W89-04462

ROLE OF STRATEGIES IN THE DEVELOPMENT OF LARGE SEWAGE TREATMENT WORKS,
Metropolitan Sanitary District of Greater Chicago, IL.
P. Lowe.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 199-207, 1988. 2 fig, 4 tab, 5 ref.

Descriptors: *Wastewater treatment, *Alternative planning, *Regional planning, *Sludge disposal, *Wastewater facilities, Water quality standards, Utilities, Multiobjective planning, Economies of scale, Operating costs, Personnel, Separated sewers, Biological wastewater treatment, England.

The development of three strategies covering the three largest sewage-treatment works owned and operated by Yorkshire Water is described. The first (West Yorkshire sludge strategy) dealt with the problems of sludge disposal in a large urban conurbation containing 51 sewage works and producing 75,000 dry tons of sludge per annum. It showed how, by providing an effective solution to the problems of the large works, the disposal routes for the smaller works also can be made secure. The second (Leeds/Aire strategy) looked at the benefits of centralizing sewage-treatment facilities at the large works, where economies of scale can give rise to reduction in manning and operating costs. It showed that such a rationalization was cost-effective only because adequate sewer capacity had been made available through a long-term policy of separating foul and surface water and existing biological-treatment facilities could be uprated to meet the increased biological load imposed by the transfer. The third (Blackburn Meadows strategy) demonstrated the benefits of looking at the problem of redevelopment of the large existing works at Sheffield from a new perspective. It assumed that an 'ideal' solution, without the constraints imposed by the existing assets, could be achieved using a 'greenfield site' concept and then used this as a standard against which to judge the more-probable alternative solutions. (Shidler-PTT)
W89-04463

METRO CHICAGO'S SLUDGE MANAGEMENT PLAN,
Metropolitan Sanitary District of Greater Chicago, IL.
J. C. Kirie, G. Majewski, and J. M. Ryan.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 209-215, 1988. 1 fig, 2 tab.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Sludge disposal, *Sludge utilization, *Chicago, Centrifugation, Dewatering, Sludge drying, Land disposal, Land reclamation, Environmental protection.

The present sludge-management plan of the Metropolitan Sanitary District of Greater Chicago is referred to as the 'Dry Solids Program'. This program meets the criteria for being environmentally-acceptable and cost-effective. The program includes several unique unit operations in what would otherwise be considered a conventional sludge-processing train that consists of thickening, stabilization, dewatering, and drying. Among the unique operations are thickening the raw sludge by centrifugation, thickening and dewatering the stabilized sludge in centrifuges or lagoons, atmospheric air-drying of the dewatered sludge on paved surfaces, and continuous use of mechanical agitating equipment during the drying season (March through October in the Chicago area) to enhance the atmospheric drying rate of the sludge. Final disposal of air-dried sludge is administered under a 'Controlled Distribution' permit issued by the Illinois Environmental Protection Agency. End usages of the air-dried sludge include: landfill cover; soil conditioner/fertilizer for sod farms, tree nurseries, golf courses, and highway right-of-ways; and land-reclamation work. (Author's abstract)
W89-04464

THICKENING OF SURPLUS SLUDGE BY MEANS OF FLOTATION,
Emschergenossenschaft, Essen (Germany, F.R.).
W. Preiss.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 217-222, 1988. 4 fig, 1 tab, 6 ref.

Descriptors: *Wastewater treatment, *Sludge thickening, *Flotation, *Sludge solids, *Sludge disposal, Activated sludge process, Sludge volume index, Operating costs, Design criteria, Pilot plants, Rhine River.

In the sewage-treatment plant at the mouth of the Emscher River domestic and industrial sewage from the catchment area of the river is treated by the activated-sludge process before it is discharged into the Rhine. In order to guarantee sludge disposal during peak accumulation periods, and to cut operating costs, it was decided to thicken the surplus sludge to a greater extent. Very good results achieved in pilot trials with a flotation plant led to this process being preferred to centrifuging and microstraining. Hence, at the Emscher Mouth Treatment Plant one existing circular thickener has been converted to a flotation unit. The operating experience gained so far with activated-sludge flotation in the converted circular thickener has lead to the following conclusions: (1) Circular basins are not very suitable for flotation because the degree of dispersion diminishes towards the periphery; (2) a basin depth of 2 m at the periphery is insufficient to permit good separation of the effluent under the floating material; (3) coarse impurities in the activated sludge make screening of the surplus sludge necessary; (4) removal of the floating material by suction pumps gives little trouble and has proved to be successful; (5) dry-solids

concentrations up to 5.5% can be achieved by activated-sludge flotation; and (6) sludge-volume indices worse than 100 ml/g have no influence on the flotation result. (Shidler-PTT)
W89-04465

HAMBURG PLANS SLUDGE DRYING,
Baubehoerde Hamburg (Germany, F.R.). Hauptabteilung Stadtentwaesserung.
E. Sickert.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 223-226, 1988. 5 fig, 1 tab, 2 ref.

Descriptors: *Wastewater treatment, *Sludge drying, *Sludge disposal, *Land disposal, *Hamburg, Ocean dumping, Landfills, Regulations, Economic feasibility, Operating costs, Sludge conditioning, Dewatering, Sludge drying, Incineration, Electric power production.

Following the example of British and American coastal towns, Hamburg began shipping digested sludge to sea in 1962. The high cost of this as well as an injunction to dispose of the digested sludge on land led to an 'interim plant' starting operation in 1983. In this plant, the digested sludge is dewatered by centrifugation and then prepared for disposal by adding lime. It is then deposited in a landfill about 80 km from Hamburg. In the design of a permanent plant, planned for 1990, the following combination of processes was found to be the most advantageous with regard to both capital and operating costs: (1) Conditioning the sludge with organic polyelectrolyte, (2) dewatering by centrifugation, (3) drying the dewatered sludge with digester gas prior to disposal, (4) generation of electricity from the remaining digester gas, and (5) using the heat from the engines of the power station to heat the digesters and the buildings. The financial advantages of drying arise mainly because transportation and disposal costs are reduced by 50% as compared to lime treatment. It would also be possible to use the dried sludge for producing asphalt; should the sludge later have to be burned, the drying could be used as a preliminary stage. Using digester gas to dry the dewatered sludge will reduce the treatment plant's operating expenses much more than using the gas to generate electricity. Thus, use of gas in the drying plant will have precedence over its use in the power plant. (Shidler-PTT)
W89-04466

SOME RECENT DEVELOPMENTS IN SEWAGE SLUDGE PUMPING,
Niersverband, Viersen (Germany, F.R.).
J. H. Lohmann, and W. F. Garber.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 227-236, 1988. 7 fig, 1 tab, 5 ref.

Descriptors: *Hydraulic machinery, *Pumps, *Pumping, *Wastewater treatment, *Sludge, Sludge solids, Volatile solids, Dewatering, Particle size, Rheology, Design criteria, West Germany, California.

The pumping of sewage-sludge solids is reviewed in terms of handling high-viscosity and low-viscosity materials with solids concentrations varying from about 4% to perhaps 50%. Knowledge of rheological characteristics, including thixotropy, is necessary in designing pumping systems. Sludge-solids percentages, volatile content, particle size, abrasives content, and temperature are variables which could change pump suitability from facility to facility. The characteristics of a sewage-collection system are also important in determining pumping parameters needed in a treatment plant. Industrial solids-handling equipment has contributed significantly to sewage-solids pumping in recent years. Included are Moyno-type progressing-cavity screw-centrifugal, recessed-impeller-rotation piston positive-displacement, and two-cylinder piston S-transfer positive-displacement pumps. These types of pumps offer the possibility of designing optimum solids-dewatering and transfer systems. The importance of reviewing industrial pumping practices for possible application to sewage sludges is illustrated by the successful application of two-cylinder-piston and rotary-piston pumps for dewatered sludge solids both at the Niersverband in the Federal Republic of Germany and in Orange County in Southern California. (Author's abstract)
W89-04467

DESIGN, TESTING AND OPERATION OF GRIT CHAMBERS WITH HYDRAULIC ROLL,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
Y. Gruber, D. Farchill, and M. Goldstein.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 237-248, 1988. 6 fig, 11 ref.

Descriptors: *Wastewater treatment, *Grit removal, *Odor control, *Design criteria, *Test procedures, Operating policies, Jets, Aeration, Scum, Hydraulic models, Simulation, Israel.

The Soreq biological-treatment plant's preliminary-treatment facilities include four grit chambers 40 m long, equipped for both grit removal and scum skimming. The variable energy input required to control the deposition of the grit and the floating of the scum is provided by a hydraulic-jet system, using pumped recycled wastewater to generate the necessary motive power. The reason for designing hydraulic-jet, instead of bubble-aeration, grit chambers is to avoid the release of noxious odors and corrosive gases which is often associated with conventional aerated grit chambers. Experiments were conducted on a hydraulic model of the grit chamber to develop the necessary design criteria for the full-scale jet system. During the plant startup program the grit chambers and related equipment were tested with clear water, and actual water velocities were measured through a range of simulated operating conditions. The performance of the Soreq grit chamber facilities, after more than four months of continuous operation with wastewater has justified the substitution of a water-jet-activated roll for a conventional compressed-air roll system, as normally used in this type of facility. The odor releases from the wastewater have been minimal and the grit produced does not emit adverse environmental nuisances under the prevailing warm climatic conditions at the site. (See also W89-04450) (Shidler-PTT)
W89-04468

WHAT ADVANTAGES CAN BE EXPECTED FROM THE ACCEPTANCE OF VARIABLE QUALITY STANDARDS FOR SEWAGE TREATMENT EFFLUENTS,
Lyonnaise des Eaux, Paris (France).
J. Bernard.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 249-251, 1988.

Descriptors: *Wastewater treatment, *Environmental protection, *Water quality standards, *Effluents, *Operating policies, Regulations, Wastewater facilities, Urban areas, Urban planning, Tourism, Eutrophication, Cost-benefit analysis, France.

Usually, environmental-protection authorities set up an unvarying minimum quality standard for river water. But the flow and water quality of rivers vary throughout the year. Thus, it would seem possible to accept variable quality standards for wastewater-treatment plant effluents. A first approach to this problem, based on three actual cases, was made by a small French task group. The cases studied were: (1) A large urban center of 4,000,000 population equivalents (PEs) in an industrial area along a river with an average flow of about 100 cubic m/s and a high-water flow of over 400 cubic m/s; (2) a large seaside town of 600,000 PEs; and (3) a town of 40,000 PEs located in a river basin where eutrophication problems are important. The provisional conclusion was reached that only in a very limited number of cases would such a regulation be suitable and economically beneficial. A policy of variable-quality effluent operation seems appropriate only for communities with highly-variable populations, such as resorts (with very different populations in and out of the 'tourist season') or 'new towns' in their development period (with a possible 2-phase construction of the treatment plant). (Shidler-PTT)
W89-04469

DAVYHULME SEWAGE TREATMENT WORKS EFFECTIVE ENERGY UTILISATION,
North West Water Authority, Manchester (England).
A. P. Jones, and N. Counsell.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 253-260, 1988. 4 fig, 4 tab, 1 ref.

Descriptors: *Wastewater treatment, *Energy, *Electric power production, *Environmental effects, *England, Utilities, Wastewater facilities, Anaerobic digestion, Sludge digestion, Sludge disposal, Resources development, Electric power rates, Powerplants, Electrical equipment, Electric power demand, Manchester.

The Davyhulme Works, the largest in the North West Water area, serves the City of Manchester and is regionally of strategic importance. It influences Authority policy in sludge disposal and has a significant environmental impact on the Mersey Estuary. During the period 1983-1985 a new anaerobic digestion plant was constructed at the works. In conjunction with this scheme, an energy-saving project was designed to generate electricity and fully utilize all the gas produced by the sludge plant. The plant uses 300-kW spark-ignition engines (which drive the induction generators) with the provision of waste heat utilization, and operates in parallel with existing dual-fuel generators. Energy has been saved to the point where the works can be almost self-sufficient in electricity production. It is now intended to extend the scheme further, so that the works becomes a net exporter of electricity. It is proposed to replace the existing six dual-fuel engines and alternators with four 1680 kW spark-ignition-engine driven generators. During the period midnight to 0700 each day, power would be purchased from the electric utility at the low night rate. At 0700, the generators would automatically start. During this period, excess power would be exported to the electric utility at the time of high payback. Total power savings of some L700,000/year have already been achieved and it is hoped to increase this to over L1,000,000/year on completion of the second stage. (Author's abstract)
W89-04470

ODOUR EMISSIONS AND ODOUR CONTROL AT WASTEWATER TREATMENT PLANTS IN WEST GERMANY,
Technische Hochschule Aachen (Germany, F.R.). Lehr- und Forschungsgebiet Angewandte Geophysik.
F.-B. Frechen.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 261-266, 1988. 4 fig, 1 tab, 9 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Odor control, *Air pollution, *West Germany, Sewage gas, Social aspects, Organoleptic properties, Measuring instruments, Olfactometry, Sludge, Sewer systems, Biofilters, Waste air treatment.

Odor emissions caused by wastewater-treatment plants can cause serious annoyance to local residents and the plant's staff. Olfactometry, which corresponds to the human sense of smell can be used to determine odor strength, but it is only a preliminary approach to quantify the effects and can advantageously be followed by questionnaire surveys of the neighborhood. Many factors contribute to the formation and release of odorous emissions. Surveys and measurement programs indicate that, considering the number of sources as well as the odor-emission strength, sludge is evidently the most critical part of a wastewater-treatment plant. Different types of waste-air treatment methods are in use in West Germany. Various simple countermeasures involving the sewerage system and the treatment plant itself are possible; covering and air-deodorization are the most extensively-used. In terms of total amount of waste air to be deodorized chemical scrubbers play the major role today, but biofilters are the most common in terms of the number of plants using them. Biological waste-air treatment systems are becoming increasingly important in West Germany. In general, an individual solution to the odor

problems has to be found according to the respective circumstances at each treatment plant. (Shidler-PTT)
W89-04471

ROTTERDAM-DOKHAVEN SEWAGE TREATMENT PLANT: A LARGE SEWAGE TREATMENT PLANT IN THE MIDST OF A DEVELOPING RESIDENTIAL QUARTER,
Hollandse Eilandenen Waarden Wastewater Authority, Dordrecht (Netherlands).
H. A. Meijer.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 267-274, 1988. 4 fig, 1 tab.

Descriptors: *Wastewater facilities, *Underground structures, *Urban development, *Environmental protection, *Rotterdam, Biological wastewater treatment, Activated sludge process, Design criteria, Ventilation, The Netherlands.

The Rotterdam/Dokhaven sewage-treatment plant (STP) has been operational since July 1987. With a biological capacity of 470,000 population equivalents it is by no means the largest STP in The Netherlands. But an underground STP with a city park on top, in the midst of a developing residential area, is very unusual. The designers had to be innovative to meet the severe environmental requirements of the Nuisance Act. The plant is characterized by extensive ventilation facilities, a two-step activated-sludge process (adsorption-biooxidation system), large-scale use of PVC linings to prevent concrete corrosion, and a separate sludge-handling site where the washed ventilation air is expelled through a chimney stack. (Author's abstract)
W89-04472

VARIABILITY OF TOXIC TRACE CONTAMINANTS IN MUNICIPAL SEWAGE TREATMENT PLANTS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, H. Monteith, and S. G. Nutt.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 275-284, 1988. 2 fig, 7 tab, 10 ref.

Descriptors: *Wastewater treatment, *Pollutant identification, *Trace metals, *Organic compounds, *Trace levels, Wastewater facilities, Municipal wastewater, Industrial wastewater, Influent water, Raw wastewater, Secondary wastewater, Effluents, Detection limits, Variability.

The variability of toxic trace contaminants in influents at three full-scale municipal sewage-treatment plants (Galt, Waterloo, and Welland, Ontario) was measured by collecting grab samples of degritted raw wastewater and non-chlorinated secondary effluent at two-hour intervals over eight consecutive days. The samples were analyzed for metals, conventional contaminants, and a range of organic trace contaminants. Metals and volatile organic compounds were the dominant contaminants found in the influents. They did not appear to be related to the type of industrial-wastewater contribution to the plants. In the effluents, organic concentrations were close to detection limits and polyaromatic hydrocarbons were almost never detected. Some influent metal and organic contaminants varied diurnally while others appeared to fluctuate randomly with periodic spike inputs. The variability of most effluent trace-contaminant concentrations was considerably attenuated in comparison to influent concentrations. Concentrations of volatile trace contaminants and most of the metal trace contaminants were lower than reported in the literature despite their variability in the influent. The metal and aromatic volatile trace contaminants appeared to follow a defined order of occurrence in the influents to all three treatment plants. A similar trend appeared to be true in the effluents for the metals. (Shidler-PTT)
W89-04473

USE OF SLUDGE AND SULPHIDE TO REMOVE HEAVY METALS FROM SEWAGES BEFORE ACTIVATED SLUDGE TREATMENT,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Licsko.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 285-292, 1988. 9 fig, 8 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Heavy metals, *Primary sludge, *Sulfides, *Sludge disposal, Chemical precipitation, Zinc, Copper, Chromium, Cadmium, Nickel, Land disposal, Costs.

The removal of five different heavy metals (zinc, copper, chromium, cadmium, and nickel) was studied under laboratory conditions using close-to-neutral mixed municipal wastewater. Ninety to 95% of the Zn, Cu, and Cr was found to precipitate within 5 min and to become removable by simple phase separation. The Cd and Ni, however, refused to precipitate, unless a 'reagent' (sulfide and primary and activated sludge) was added. In the presence of these, cadmium was normally more-readily removed than nickel. Both heavy metals were removed most efficiently when primary sludge (1.4 g/cubic dm) and sulfide ions (5-15 mg/cubic dm) were added in combination. As demonstrated by plant trials, this treatment would cause the heavy metals to precipitate and settle out in the primary settling tank, so that traces only would enter the aeration tank. The excess sludge would thus contain only trace quantities of heavy metals, removing an obstacle to land disposal. The introduction of this process stage has been estimated to increase overall construction costs by 2.3% and the unit cost of sewage and sludge treatment by 6%. (Author's abstract)
W89-04474

JOINT SEWAGE TREATMENT PLANT I, MOENCHENGLADBACH-NEUWERK: A REVIEW OF THE PAST 50 YEARS AND ITS FUTURE UPGRADING,
Niersverband, Viersen (Germany, F.R.).
G. Kugel, and E. Zingler.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 293-301, 1988. 4 fig, 2 tab, 19 ref.

Descriptors: *Wastewater facilities, *Design criteria, *Operating policies, *Future planning, *West Germany, Industrial wastewater, Storm wastewater, Activated sludge process, Anaerobic digestion, Retention time, Energy, Land disposal, Sewage gas, Methane.

Joint Sewage Treatment Plant I (JSTP I) was initially designed to treat 50,000 cubic m/d by a 2-stage activated-sludge process with integrated charcoal precipitation and was enlarged 25 years ago to treat 130,000 cubic m/d dry-weather flow. It now treats 650,000 population equivalents, half of which is industrial effluent, mainly from textile and food-processing factories. Sludge treatment has always included digestion and this is to be upgraded to 2-stage thermophilic and mesophilic digestion with submerged-combustion sludge heating. The upgrade will include biological treatment of an increasing storm-water flow, and a shorter solids-retention time during thickening for better electric-energy conservation by a significant reduction of COD load at the first biological stage. Based on long-term experience in sludge digestion with submerged-combustion burner pre-heating, the total electric energy consumption of sludge digestion will range about 7-7.5 kWh/cubic m sludge input. The sludge produced has always been disposed of on land, with or without drying with digester gas, and some has been centrifuged. The gas has also been used for car fuel but it is now purified and blended into the gas supply of a public utility. The overall methane yield from a high-rate two-stage thermophilic/mesophilic digestion will be at least the same as from the medium-rate mesophilic digestion now run at JSTP I. The two-stage digestion will stabilize a daily 1000 cubic m sludge volume before application to arable land and pasture. (Shidler-PTT)
W89-04475

EXPANSION OF ADVANCED WASTEWATER TREATMENT FACILITIES AT WASHINGTON, D.C.,
District of Columbia Dept. of Environmental Services, Washington. Water Resources Management Administration.
W. F. Bailey, and T. G. Shea.
Water Science and Technology WSTED4, Vol. 20, No. 4/5, p 303-313, 1988. 3 fig, 7 tab, 1 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Advanced wastewater treatment, *Project planning, *Water quality standards, *District of Columbia, Urban areas, Design flow, Cost analysis, Design criteria, Activated sludge process, Dewatering, Incineration, Potomac Estuary, Environmental protection.

The District of Columbia's Blue Plains Advanced Wastewater Treatment Facility provides wastewater treatment for approximately 2,000,000 people residing in the Washington, D.C. Metropolitan Area. The current design flow rate is 13.5 cubic m/s. The plant discharges into the Potomac Estuary and is required to meet some of the most stringent effluent quality standards in the United States. Advanced treatment facilities have now been in full service for only 3 years, but the design flow rate has been reached. The facilities are being expanded and upgraded to provide increased capacity. Although available space is extremely limited, it was determined that expansion of the existing plant to 16.2 cubic m/s was the most cost-effective alternative for the region. In order to continue meeting the discharge limitations, modifications will be made to the secondary and nitrification activated-sludge systems, wastewater filters, disinfection system, and plant instrumentation. Major upgrades are planned for sludge processing including construction of centrifuge and filter-press dewatering facilities, mechanical composting, and fluid-bed incineration. By 1992, after an expenditure in excess of $400 million, facilities will be in place to meet the needs of the Blue Plains service area for the next 20 years. Compliance with effluent standards will be accomplished and Potomac River water quality will continue to be protected. (Shidler-PTT)
W89-04476

5E. Ultimate Disposal Of Wastes

EFFLUENT DEWATERING RESEARCH FOR MSW AND WASTEWATER TREATMENT SLUDGES,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5D.
W89-03378

FOREST LAND APPLICATION OF MUNICIPAL SLUDGE,
Michigan Dept. of Natural Resources, Lansing. Land Application Unit.
D. G. Brockway.
Biocycle BCYCDK, Vol. 29, No. 9, p 62-68, October 1988. 5 fig, 6 tab, 24 ref. EPA assistance agreement S005551.

Descriptors: *Land disposal, *Sludge utilization, *Municipal wastes, *Forests, Michigan, Cycling nutrients, Plant growth, Groundwater pollution, Cost analysis, Social aspects, Environmental policy.

Sites selected for land application were located in Montmorency County in the Mackinaw State Forest in northeastern lower Michigan. Land-applied sludge substantially enhanced nutrient cycling, tree growth, wildlife habitat, and the nutritional quality of forage plants in the forest. At appropriate application rates, these benefits were obtained while avoiding groundwater contamination and toxicant transmission in the food chain. Forest land-application methods were shown to be technologically feasible and cost effective. Such results could reasonably be anticipated when wastewater sludge is applied in similar forest ecosystems, as those found in the Upper Great Lakes and Northeastern regions of the United States. Forest land application of sludge has great potential to become a socially-acceptable operation, provided accurate information is made available to the public. Environmental and natural-resources managers in Michigan are committed to further devel-

opment and utilization of this technology in agency programs. (Author's abstract)
W89-03396

LEACHABILITY OF TECHNETIUM FROM CONCRETE,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung.
For primary bibliographic entry see Field 5B.
W89-03403

EFFECT OF CADMIUM-BEARING SEWAGE SLUDGE ON CROP PLANTS AND MICROORGANISMS IN TWO DIFFERENT SOILS,
Naples Univ. (Italy). Ist. di Microbiologia Agraria.
S. Coppola, S. Dumontet, M. Pontonio, G. Basile, and P. Marino.
Agriculture, Ecosystems and Environment, Vol. 20, No. 3, p 181-194, June 1988. 3 fig, 7 tab, 22 ref.

Descriptors: *Sludge utilization, *Land disposal, *Environmental effects, *Cadmium, *Crop production, *Microorganisms, *Soil types, Italy, Clay, Dry matter, Plant physiology, Biomass, Adenosine triphosphate, Chemical analysis, Sodium nitrate, EDTA, Calcium chloride.

The metal-bonding capacities of two regional soils of southern Italy were evaluated. A volcanic soil, with a high percentage of vitreous material and very low clay content, and a sample of 'terra rossa', rich in iron oxides and with a high percentage of non-expansible kaolinite-type clay, were treated with sludge spiked with cadmium sulfate to obtain 0, 2, 4, 8, and 16 ppm of total cadmium in the soil. Cadmium uptake and cadmium effects on dry-matter production of rye grass, spinach, dwarf bean, and radish grown in the two soils and the effects of cadmium on soil microflora were investigated. The effect upon physiology and biomass of plants and microorganisms depended on the cadmium dose and on the type of soil, plant, or microorganism. Cadmium uptake was always lower in crops grown on 'terra rossa' than in those grown on volcanic soil. Evaluation of soil microbial biomass with ATP showed an adverse cadmium influence only at 16 ppm in volcanic soil. In the chemical assessment of biologically-available cadmium, different results were obtained with three different analysis methods. Extraction from neutral soil, poor in organic matter, with 0.1 M NaNO3 gave low estimates of cadmium. On the other hand, extraction with ammonium acetate and EDTA seemed to produce overestimated values, since the results were near the total metal content. For the types of soils assayed in this study better correlations between plant response and analytical evaluations could be achieved through extraction with 0.1 M calcium chloride solutions. (Shidler-PTT)
W89-03410

EFFECT OF SEWAGE SLUDGE APPLICATION TO BERMUDAGRASS ON FORAGE QUALITY, PRODUCTION, AND METAL ACCUMULATION,
Sam Houston State Univ., Huntsville, TX. Dept. of Agriculture and Natural Resources.
R. A. Lane.
Agriculture, Ecosystems and Environment, Vol. 20, No. 3, p 209-219, June 1988. 8 tab, 16 ref.

Descriptors: *Sludge utilization, *Fertilization, *Forages, *Crop production, *Bioaccumulation, Bermudagrass, Nitrogen, Phosphorus, Potassium, Dry matter, Proteins, Zinc, Chromium, Mercury, Copper.

A bermudagrass (Cynodon dactylon, cultivar Alicia) sod was top-dressed with nutrient rates of 0-0-0, 180-78-20, 360-156-40, and 540-234-60 kg/ha nitrogen, phosphorus, and potassium from commercial fertilizer and dried anaerobically-digested sewage sludge. Mean seasonal dry-matter production was similar regardless of nutrient source, but higher rates generally resulted in significantly-higher yields. Treatment of forage with sludge rather than commercial fertilizer gave a higher crude-protein content only at the 360-156-40 rate. In-vitro dry-matter digestibility was significantly lower at the medium and high sludge rates. All other treatments were not significantly different. Total zinc levels in forage from all sludge treatments were relatively uniform. Chromium concentration was highest in the medium sludge rate and was lowest with the highest rate of commercial fertilizer among plots treated with supplemental nutrients. Mercury concentration did not vary with nutrient source. Copper concentrations were generally twice as high in sludge-treated compared with conventionally-fertilized forage. In no case did the metal concentration pose a threat to grazing animals. (Author's abstract)
W89-03412

MOVEMENT AND SPECIATION OF HEAVY METALS IN A SOIL AMENDED WITH SEWAGE SLUDGE CONTAINING LARGE AMOUNT OF CD AND NI (MIGRATION ET SPECIATION DES METAUX LOURDS DANS UN SOL SOUMIS A DES EPANDAGES DE BOUES DE STATION D'EPURATION A TRES FORTE CHARGE EN CD ET NI),
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 5B.
W89-03431

AMAZING ECONOMICS OF WASTEWATER REUSE,
For primary bibliographic entry see Field 5D.
W89-03452

RESPONSE OF AN ALASKAN WETLAND TO NUTRIENT ENRICHMENT,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5D.
W89-03463

DYES IN THE ENVIRONMENT: DYEING WASTES IN LANDFILL,
Georgia Inst. of Tech., Atlanta. School of Textile Engineering.
For primary bibliographic entry see Field 5B.
W89-03617

CHEMICAL ANALYSIS OF DISTRIBUTION AND MARKETING (D AND M) MUNICIPAL SLUDGES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
W. E. Coleman, R. Baird, and S. M. Gabrielian.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 366-367. 5 ref.

Descriptors: *Toxic wastes, *Chemical analysis, *Sludge disposal, *Municipal wastewater, *Biodegradation, *Organic compounds, *Metals, *Trace metals, Wastewater treatment, Phenols, DDT, Polychlorinated biphenyls, Chlordanes, Halogenated pesticides, Gas chromatography, Aromatic compounds.

The occurrence of chemicals in distribution and marketing sludges was determined to provide a data base of priority pollutant metals and organics from sludges produced at facilities in 26 cities across the U.S. Efforts were also made to characterize non-target organic chemicals in sample extracts from each city using gas chromatography/mass spectrometry. Of the 15 trace metals analyzed, all but beryllium and thallium were detected 100% of the time in all 67 composite samples. Beryllium as at low but detectable concentrations in 97% of the samples, but thallium was never detected. Volatile priority pollutant organics were rarely detected, hence this group of compounds appears to have little significance in sludge products. Relatively few of the extractable priority pollutant organics were detected in any of the samples. Bis-(2-ethylhexyl)phthalate was detected in all samples; two-, three- and four-ring polycyclic aromatic hydrocarbons, phenols, chlordane, and DDT metabolites were found in several samples. Six other compounds were detected in one sample each. The polychlorinated biphenyl mixture, Aroclor 1248, was detected in two samples. The gas chromatography/mass spectrometry characterization of major organic components in 26 sludge extracts did not reveal any new compounds. There was a preponderance of compounds which belong to aliphatic, phenolic, and carboxylic acid classes; and baseline hump characteristic of petroleum residues was apparent in the majority of samples. (See also W89-03595) (Miller-PTT)
W89-03642

CAN CHLOROPHENOLS - DECONTAMINATED THROUGH BINDING TO HUMIC ACID - BE RELEASED,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
J. Dec, and J. M. Bollag.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 425-426. 2 tab.

Descriptors: *Toxic wastes, *Waste disposal, *Water pollution prevention, *Fate of pollutants, *Chlorinated hydrocarbons, *Decomposing organic matter, *Phenols, Chlorophenols, Humic acids, Soil bacteria.

To evaluate the problem of the possible release of humus-bound chemicals and related delayed pollution effects, several C14-labelled chlorophenols were exposed to microbial soil populations and the release of C14-labelled substances into the media and CO2-14 formation were monitored during a 3-month incubation period. The quantity of CO2-14 evolved varied with microbial consortia (up to 10% of initially bound radioactivity) and it was dependent on the chemical structure of the bound compound; it decreased with increasing number of chlorine atoms on the aromatic ring. As found by high performance liquid chromatography, the C14-labelled substances released into the media (up to 12%) consisted mostly of unchanged chlorophenols with minor quantities of 2 to 4 unidentified chemicals. Some radioactivity was also released into sterile media by abiotic factors. Most radioactivity remained associated with the humus polymers, indicating that bound chlorophenols are unlikely to adversely affect the environment. (See also W89-03595) (Author's abstract)
W89-03654

AREAWIDE SEWAGE SLUDGE TREATMENT AND DISPOSAL PROJECT -- ACE PLAN,
Japan Sewage Works Agency, Tokyo.
For primary bibliographic entry see Field 5D.
W89-03660

AUTOGENOUS INCINERATION OF SEWAGE SLUDGE BY RECOVERING THE HEAT OF EXHAUST GAS,
Tokyo Sewerage Bureau (Japan).
For primary bibliographic entry see Field 5D.
W89-03661

BENEFICIAL UTILIZATION OF SEWAGE SLUDGE,
Public Works Research Inst., Tokyo (Japan). Ultimate Disposal Section.
For primary bibliographic entry see Field 5D.
W89-03662

SELECTED MUNICIPAL SLUDGE TOPICS.
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W89-03672

USE OF FLEXIBLE MEMBRANES IN PROTECTION OF GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W89-03730

PROMISING AND AFFORDABLE SOLUTION TO SLUDGE TREATMENT,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W89-03733

PATHOGEN RISK ASSESSMENT FEASIBILITY STUDY.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5C.
W89-03746

EFFECTS OF COMPOSTED MUNICIPAL SLUDGE ON SOILBORNE PLANT PATHOGENS,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Plant Pathology.
H. A. J. Hoitink, and A. F. Schmitthenner.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-195714. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/024, April 1988. 59p, 6 fig, 17 tab, 52 ref. EPA Contract CR-810581.

Descriptors: *Compost, *Sludge utilization, *Soil treatment, *Land disposal, Salts, Fungi, Plant diseases, Soybeans, Soil fungi.

Composted municipal sludge (CMS) increased soybean yields by improving soil fertility and/or by partial control of Phytophthora root rot. This biological control was realized only if CMS was applied at rates of 40 tonnes dry wt/ha well ahead of planting with tolerant cultivars so that soluble salts introduced with the CMS leached out. The disease was enhanced by applications of CMS just before planting. Ridomil 5E, a selective Phytophthora fungicide, controlled this disease-enhancing effect of CMS on soybean. Container media formulated with CMS cured 4 months consistently suppressed Pythium root rot and damping-off diseases of ornamentals over a 2-yr production period. Rhizoctonia diseases were suppressed consistently only if media prepared with CMS were stored 4 wks prior to their utilization. These media remained suppressed for a 2 yr period. Several microbial antagonists were isolated from CMS media that provided biological control of the two diseases of ornamental plants. (Author's abstract)
W89-03770

HAZARDOUS WASTE SITE MANAGEMENT: WATER QUALITY ISSUES. REPORT ON A COLLOQUIUM SPONSORED BY THE WATER SCIENCE AND TECHNOLOGY BOARD. COLLOQUIUM 3.
National Research Council, Washington, DC. Water Science and Technology Board.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-170592. Price codes: A10 in paper copy, A01 in microfiche. February 19-20, 1987. 212p.

Descriptors: *Water pollution control, *Waste disposal, *Waste management, *Water pollution prevention, Symposium, Hazardous wastes, Cleanup operations, Water quality control, Regulations, Geohydrology, Toxicology.

A collection of papers from a colloquium sponsored by the Water Science and Technology Board (WSTB) of the National Research Council, discusses ground and surface water cleanup levels at hazardous waste sites and evaluates whether the scientific, technical, and regulatory methods currently used for setting cleanup levels are adequate. Current methods used by regulatory agencies and the Department of Defense to establish water quality cleanup levels, and provides insight from representatives of water utilities, industry, regulatory agencies and citizens groups, are addressed. The report also reviews the use of models and other methods for estimating health risks at hazardous waste sites, and looks at the roles of geohydrology, engineering, risk assessment, and toxicology, and regulatory strategies in hazardous waste site management. (See W89-03784 thru W89-03791) (Lantz-PTT)
W89-03783

ESTIMATING HEALTH RISKS AT HAZARDOUS WASTE SITES: DECISIONS AND CHOICES DESPITE UNCERTAINTY,
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 6A.
W89-03791

COUPLED GROUNDWATER FLOW AND SOLUTE TRANSPORT WITH FLUID DENSITY STRONGLY DEPENDENT UPON CONCENTRATION,
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
For primary bibliographic entry see Field 2F.
W89-03815

SOIL PROFILE N, P, AND K CHANGES FORM INJECTED LIQUID DAIRY MANURE OR BROADCAST FERTILIZER,
Cornell Univ., Ithaca, NY. Dept. of Soil Science.
S. D. Comfort, P. P. Motavalli, K. A. Kelling, and J. C. Converse.
American Society of Agricultural Engineers, Transactions TAAEAJ, Vol. 30, No. 5, p 1364-1369, September-October 1987. 4 fig, 5 tab, 20 ref.

Descriptors: *Waste disposal, *Reuse, *Fertilizers, *Manure, Animal wastes, Corn, Crop production, Nitrogen, Phosphorus, Potassium, Dentrification, Loam, Soil chemistry.

This study compared N, P and K concentrations in soils that received injected dairy manure and broadcast inorganic fertilizers for 3 years. Nitrogen from manure and inorganic fertilizer was applied at approximately 84, 168, and 252 kg N/ha/yr in 1982 through 1984. Inorganic P and K fertilizers were applied to match the application rates for expected available P and K in the manure. Corn (Zea mays L.) was grown on treatment plots in 1982 through 1985 at 3 locations in south-central Wisconsin. Soil types were a Puchyan loamy fine sand (Arenic Hapludalf), Plano silt loam (Typic Argiudoll), and a Tama silt loam (Typic Argiudoll). Silage and grain yield, nutrient uptake, and soil N, P, and K concentrations were determined. More total inorganic N in the soil profile and faster downward movement were found under the fertilizer treatments than the manure treatments. Greater loss of manure N from denitrification is suggested for this difference. Buildup of soil P and K concentrations was observed only after 2 and 3 annual additions of high rates of manure or fertilizer, and was confined primarily to the 0 to 30 cm layer. The additional organic nutrient components of the manure resulted in more total N, P, and K applied than that applied from the inorganic fertilizer. This additional organic component was not reflected in soil test values of in the N, P, and K removed by the corn silage. (Author's abstract)
W89-03829

DREDGED MATERIALS - PROBLEMS ASSOCIATED WITH THEIR USE ON LAND,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
R. G. V. Bramley, and D. L. Rimmer.
Journal of Soil Science JSSCAH, Vol. 39, No. 3, p 469-482, September 1988. 2 tab, 40 ref.

Descriptors: *Dredging, *Soil management, *Heavy metals, *Spoil disposal, *Land disposal, *Waste disposal, Land use, Land reclamation, Soil moisture retention, Hydrogen ion concentration, Nutrients, Spoil banks, Public health, Soil contamination.

The use of river and harbor dredgings in reclamation projects worldwide is reviewed. Potential land uses are considered where the emphasis is placed on the growth of plants, such as agricultural and public recreation areas. Physical and chemical problems associated with the use of dredgings in such projects are identified, and crop responses on these materials are discussed. Health risks to man and animals associated with using dredged materials are also considered. Physical problems such as high water-holding capacity do not limit the use of dredged materials provided that the period of ripening is of sufficient length. High heavy metal contents, nutrient imbalance and unfavorable pH are seen as the major constraints to the use of dredged materials as growth media. It is concluded that with careful ripening, and monitoring of chemical parameters, dredged materials may be of considerable use in many reclamation projects. (Author's abstract)
W89-03918

HAZARDOUS WASTE: WHERE TO PUT IT - WHERE WILL IT GO,
Argonne National Lab., IL.
N. F. Sather.
Mechanical Engineering MEENAH, Vol. 110, No. 9, p 70-75, September 1988.

Descriptors: *Hazardous wastes, *Waste disposal, *Fate of pollutants, *Waste management, Incineration, Land disposal, Remote sensing, Organic wastes, Recycling, Oxidation, Wastewater treatment, Sludge disposal, Monitoring, Detoxification, Decontamination.

The mounting cost of managing hazardous wastes has spurred new research to develop better and less costly waste treatment and site remediation technologies. A single-step, low-cost thermal treatment process of waste glassification has been developed by Northwest Laboratory for destroying organics, encapsulating heavy metals, and significantly reducing volume. Toxic contaminants in the waste are immobilized in an inert, glass-based material, and the volume of the waste product may be reduced up to 90%. The glassification process includes an effluent treatment system that removes and neutralizes acid gases generated by the combustion of nitrate-bearing materials and certain plastics. The first project under the Department of Energy's Hazardous Waste Remedial Actions Program (HAZWRAP) will demonstrate a detoxification method for mixed sludges using the X-Trax process developed by Chemical Waste Management, Inc. Destroying hazardous organic chemicals by oxidation in supercritical water is under investigation at Los Alamos National Laboratory with funding from HAZWRAP. Fourier transform infrared spectrometry is being adapted to the monitoring of incinerator emissions. The monitoring system can also be interfaced with process control equipment to provide warning signals if a given compound exceeds a specified level. Pacific Northwest Laboratory has developed an innovative soil-melting method with applications in hazardous waste treatment, soil stabilization, and construction. This in situ vitrification method is now available for commercial use. A new system that facilitates the preparation of site-contamination surveys based on surface measurements obtained from portable instruments has been developed at Oak Ridge National Laboratory. This ultrasonic ranging and data system automatically determines a surveyor's position and links it with other survey data being collected at the same time. Scientists at Lawrence Livermore National Laboratory have developed a portable in situ groundwater monitor with funding from HAZWRAP. The monitor combines optically active chemical probes (optrodes) with fiber optics to detect toxic organics. (Geiger-PTT)
W89-03919

CLAYEY BARRIER ASSESSMENT FOR IMPOUNDMENT OF DOMESTIC WASTE LEACHATE (SOUTHERN ONTARIO) INCLUDING CLAY-LEACHATE COMPATILIBILITY BY HYDRAULIC CONDUCTIVITY TESTING,
University of Western Ontario, London. Faculty of Engineering Science.
R. M. Quigley, F. Fernandez, and R. K. Rowe.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 3, p 574-581, August 1988. 9 fig, 1 tab, 24 ref.

Descriptors: *Groundwater barriers, *Water pollution prevention, *Hydraulic conductivity, *Landfills, *Water quality control, *Clays, *Leachates, Groundwater, Channel flow, Potassium, Model studies, Soil types.

The current use of engineered clayey barriers to control the chemical flux entering the groundwater adjacent to landfill sites is discussed. New analytical methods to predict flux are presented briefly, followed by an assessment of macropore flow problems inherent in laboratory and field-compacted clays. The clay leachate compatability of southern Ontario clays is then assessed with respect to domestic waste leachate using hydraulic conductivity as the assessment tool. The dominant role of channel flow through macropores, even in very carefully controlled laboratory samples, is emphasized, as is the critical role of soil smectite and vermiculite in retardation of species such as potassium from domestic leachate. The Sarnia brown and gray clays seem compatible with domestic waste leachate at least with respect to hydraulic conductivity. In spite of extensive potassium retardation, leachate effected a slight decrease in hydraulic conductivity of the water-compacted brown and gray samples, a feature also observed recently for the contaminated gray clay zone at a field site. (Author's abstract)
W89-03971

APPLICATION OF VARIABLY SATURATED FLOW THEORY TO CLAY COVER LINERS,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller, and S. J. Wright.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1283- 1300, October 1988. 6 fig, 2 tab, 26 ref, 2 append.

Descriptors: *Leachates, *Linings, *Landfills, *Saturated flow, *Leakage, *Clays, Flow, Precipitation, Soil types, Model studies, Darcys law, Simulation, Sensitivity analysis, Permeability, Leachates, Evapotranspiration, Boundary conditions, Mathematical models, Seepage, Drainage.

The movement of precipitation through the upper layers of a waste landfill may be described by a variably saturated flow model based on Darcy's equation. Such a model predicts moisture transport through clay liners for a specified site design and climatology. Example simulations are presented to highlight the difference between this approach and more prevalent moisture routing techniques. The model was used to simulate water movement through the clay barriers covering test cells at an existing research site. The simulated leakage was significantly less than that observed, suggesting that flow through macropores and other discontinuities may be dominant. A sensitivity analysis of model parameters indicates that linear thickness and saturated permeability are most critical to the leakage solution, while refuse properties have a more limited impact, especially prior to saturation of the liner. (Author's abstract)
W89-03983

HYDROGEOLOGY AND GROUNDWATER QUALITY AT A LAND RECLAMATION SITE, NESHAMINY STATE PARK, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
R. S. Blickwedel, and J. H. Linn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4164, 1987. 41p, 19 fig, 7 tab, 16 ref.

Descriptors: *Sludge disposal, *Soil reclamation, *Water quality data, *Pennsylvania, Unconsolidated aquifers, Groundwater movement, Bucks County, Neshaminy State Park.

In September 1981, infertile sand and silt dredge spoil from the Delaware River at Neshaminy State Park was mixed with composted sewage sludge and seeded to grasses to produce a soil product that has not adversely affected groundwater quality as of March 1985. Analyses for pH, specific conductance, nutrients, and heavy metals in groundwater at the beginning of the study indicate that the chemistry of the groundwater in the dredge spoil at the sites differ from that found in the 'Trenton gravel' of Pleistocene age. Analyses of groundwater samples collected after the first two sludge applications (120 tons/acre and 450 tons/acre) indicate that no significant change occurred in the chemistry of the samples from the Trenton gravel, whereas organic nitrogen increased temporarily in groundwater from the dredge spoil 6 months after the larger of the two sludge applications but quickly returned to background levels. The lack of chemical change with time in the groundwater implies either that little of the more than 100 inches of precipitation that fell from April 1983 through March 1985, reached the water table or, more likely, that a mechanism exists, beneath the soil-factory site that retards or prevents the downward migration of contaminants. (USGS)
W89-04072

SURFACE-RUNOFF MEASUREMENT AND SEDIMENT-SAMPLE-COLLECTION SYSTEM FOR SMALL AREAS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04097

GEOLOGIC, HYDROLOGIC, AND CULTURAL FACTORS IN THE SELECTION OF SITES FOR THE LAND DISPOSAL OF WASTES IN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion, R. C. Alvord, and T. D. Olson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4279, 1986. 16p, 12 pl, 28 ref.

Descriptors: *Waste disposal, *Land use, *Washington, *Geohydrology, *Land disposal, Aquifers, Earthquakes, Volcanoes, Water use, Population density, Maps.

As part of a program to deal with the problems of waste disposal in Washington, the Department of Ecology (WDOE), in cooperation with the U.S. Geological Survey, completed a study designed to provide the geologic, hydrologic, and cultural data needed to evaluate the suitability of State land areas for the disposal of wastes. Data portraying the distribution of factors that could affect the suitability of areas in Washington for waste disposal were presented in a series of 18 maps (overlays). The factors selected include major geologic units; natural hazards from earthquakes, faulting, and volcanoes; climate; locations of major surface-water and groundwater bodies; population density; and land and water uses. Within each factor (map) the data were grouped into class intervals and the intervals for most factors ranked according to their relative suitability/unsuitability for land disposal of wastes following criteria supplied by WDOE. Areas of the State considered completely unsuitable (as determined by WDOE personnel) for waste disposal because of current or proposed land uses were excluded from ranking. (USGS)
W89-04115

RECORDS OF WELLS AND CHEMICAL ANALYSES OF WATER FROM WELLS FOR THE PERIOD JUNE 13, 1984 TO DECEMBER 4, 1986 AT THE MAXEY FLATS RADIOACTIVE WASTE DISPOSAL SITE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
M. A. Lyverse.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-214, 1987. 53p, 2 fig, 2 tab, 2 ref.

Descriptors: *Radioactive wastes, *Injection wells, *Waste disposal wells, *Water quality, *Kentucky, Fleming County, Water analysis, Lithologic data, Waste disposal, Water levels.

Lithologic data are presented for 113 wells drilled at the Maxey Flats Radioactive Waste Disposal Site for the period June 13, 1984 to December 4, 1986. Water levels, tritium concentrations, and specific conductance are also presented for wells yielding sufficient water for measuring and sampling. At least one sample was collected from most wells for the determination of gross alpha and beta activity. These activities and the results for gamma emitting radionuclides (Cobalt 60 and Cesium 137) are also presented. (USGS)
W89-04144

GEOHYDROLOGIC CONDITIONS AT THE NUCLEAR FUEL REPROCESSING PLANT AND WASTE-MANAGEMENT FACILITIES AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04178

DISPOSAL OF LEATHER TANNERY WASTES BY LAND TREATMENT: A REVIEW,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
J. C. Hughes.
Soil Use and Management, Vol. 4, No. 3, p 107-111, September 1988. 1 fig, 2 tab, 37 ref.

Descriptors: *Tannery wastes, *Sludge disposal, *Land disposal, *Path of pollutants, *Chromium, *Sludge properties, *Soil amendments, Self-purification, Literature review, Heavy metals, Nutrients, Sodium, Nitrogen, Phosphorus, Magnesium, Groundwater pollution, Water pollution sources, Nitrates.

Leather tanneries produce a large amount of sludge and liquid wastes. The liquids contain much sodium and in most circumstances adversely affect both the soil and the groundwater. However, in some countries they are used for irrigation. The sludges contain N, Ca, Mg, P, Cr III, and some Na. Given careful management these sludges can be used as soil amendments, either directly or after composting. Application rates of about 200 tonnes/ha have proved toxic to crops in pot trials, though in larger applications than this they have not affected crops in the field. Much smaller rates, of less than 20 tonnes/ha, have been used in the field to minimize nitrate contamination of groundwater. The effects of Cr III depend on complex interactions among the sludge, the soil to which it is added, and the plant species grown. Safe limits for the disposal of the sludges and their long-term effects are not known. (Author's abstract)
W89-04213

RESIDUES OF DETERGENT-DERIVED ORGANIC POLLUTANTS AND POLYCHLORINATED BIPHENYLS IN SLUDGE-AMENDED SOIL,
Venice Univ. (Italy). Dept. of Environmental Science.
A. Marcomini, P.D. Capel, W. Giger, and H. Hani.
Naturwissenschaften NATWAY, Vol. 75, No. 9, p 460-462, September 1988. 1 fig, 1 tab, 8 ref.

Descriptors: *Pollutants, *Path of pollutants, *Soil amendments, *Sludge disposal, Sludge, Polychlorinated biphenyls, Organic pollutants, Nonylphenol polyethoxylates, Detergent-derived organic pollutants, Leaching, Groundwater pollution, Land disposal.

Linear alkylbenzene sulphonates and nonylphenol polyethoxylates are widely used anionic and non-ionic synthetic aromatic surfactants. Field investigations were performed to obtain better insights into the fate of these detergent-derived chemicals in the soil environment. Organic carbon and polychlorinated biphenyls were also determined. Samples of sludge-amended soils were collected from an experimental plot that had received a total of 142 t(d.w.)/ha of digested sewage sludge since 1976. The results suggest that accumulation of linear alkylbenzene sulfonates, nonylphenol polyethoxylates (n = 1 & 2), and polychlorinated biphenyls is occurring in sludge-amended soils. The best-case scenario is that the observed residuals are threshold concentrations for biological transformation, and will not increase with addi-

tional sludge applications. The worst-case scenario is that concentrations increase with each addition of sludge. Further investigations are needed to determine if the entrance into the food chain through soil ingestion by animals and leaching into the groundwater of these residuals are environmental concerns. (White-Reimer-PTT)
W89-04297

ACTUAL SLUDGE PRODUCTION IN MUNICIPAL SECONDARY WASTEWATER TREATMENT PLANTS,
Kuwait Univ., Safat. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-04316

SLUDGE CONDITIONING WITH MORINGA SEED.
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-04318

FULL-SCALE LAND TREATMENT OF COFFEE PROCESSING WASTEWATER,
Texas Univ. at Arlington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-04369

MICROORGANISM LEVELS IN AIR NEAR SPRAY IRRIGATION OF MUNICIPAL WASTEWATER: THE LUBBOCK INFECTION SURVEILLANCE STUDY,
Southwest Research Inst., San Antonio, TX.
D. E. Camann, B. E. Moore, H. J. Harding, and C. A. Sorber.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1960-1969, November 1988. 2 fig, 10 tab, 32 ref.

Descriptors: *Pollutant identification, *Air pollution, *Path of pollutants, *Spray irrigation, *Municipal wastewater, *Land disposal, *Microorganisms, Bacteria, Wastewater, Environmental effects, Enteroviruses, Infection, Aerosols.

The Lubbock Infection Surveillance Study (LISS) investigated possible adverse effects on human health from slow-rate land application of municipal wastewater. Extensive air sampling was conducted to characterize the irrigation site as a source of infectious microbial aerosols. Spray irrigation of poor-quality wastewater received directly from the treatment plant significantly elevated air densities of fecal coliforms, fecal streptococci, mycobacteria, and coliphage above ambient background levels for at least 200 m downwind. Enteroviruses were repeatedly recovered at 44 to 60 m downwind at a higher level than observed at other wastewater aerosol sites in the United States and Israel. Wastewater storage in reservoirs reduced downwind air densities of indicator organisms by two orders of magnitude. (Author's abstract)
W89-04371

STUDY OF REACTION KINETICS FOR THE PYROLYSIS OF BIOGENIC SLUDGE,
Oldenburg Univ. (Germany, F.R.). Fachbereich 9 - Chemie.
D. Schuller, and J. Mieglitz.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 599-608, July 1988. 2 fig, 9 ref.

Descriptors: *Sludge disposal, *Mathematical models, *Pyrolysis, Reaction kinetics, Chemical analysis, Biogenic sludge.

An investigation of sewage sludge pyrolysis was carried out to optimize reaction parameters. The analysis of kinetic parameters was done using a new computer program. Activation enthalpy and the order of reaction have been determined for the main phase of sewage sludge pyrolysis from thermogravimetric data using that program. The order of reaction was found to be about 1 and the activation enthalpy in the order of 60 kJ/mole. Kinetic data provide a certain understanding of the primary reaction. This value is in the order of evaporation enthalpies of organic compounds, which suggests that the decomposition of solid sludge is mainly characterized by an evaporation process. Different pretreatments of the sludge, such as drying, conditioning with metal compounds, or grinding of dry material, did not influence the test results significantly. Only when higher heating rates were applied did the order of reaction increase. (Brock-PTT)
W89-04397

MICROFLORA IN THE COMBINED FACULTATIVE POND AND AERATED LAGOON SYSTEM AT A SEA-BASED SOLID WASTE DISPOSAL SITE,
Gifu Univ. (Japan). Dept. of Agricultural Chemistry.
K. Kawai, H. Horitsu, K. Takamizawa, and Z. Inoue.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 677-688, July 1988. 9 fig, 3 tab, 12 ref.

Descriptors: *Solid waste disposal, *Biological treatment, *Aerated lagoons, *Leachates, Microflora, Facultative ponds, Sea-based solid waste disposal site, Waste disposal.

In Osaka city, solid waste has been disposed of in a pond at a sea-based solid waste disposal site. The leachate is treated by the combined process of a facultative pond and aerated lagoon. The microflora of the combined process were examined and the relationship between leachate loading and microbial activities was clarified. BOD5 (biological oxygen demand) in the aerated lagoon was stable, being below 20 mg/L year round. The dominant genera in the aerated lagoon were Alcaligenes, Micrococcus, Moraxella, Aeromonas and Acinetobacter during the lower leachate loading period. There were no pathogenic bacteria of the genera Salmonella, Shigella and Vibrio in the aerated lagoon. (Author's abstract)
W89-04402

FIELD INVESTIGATION OF CLAY LINER PERFORMANCE,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-04416

DESIGN OPTIMIZATION FOR SOLIDIFICATION OF HAZARDOUS WASTES,
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
H. S. Shin, N. R. Her, and J. K. Koo.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 3, p 239-250, Summer 1988. 8 fig, 6 tab, 10 ref.

Descriptors: *Electroplating, *Sludge disposal, *Solidification, *Hazardous materials, *Waste disposal, *Chemical sludge, *Heavy metals, *Design standards, Structural engineering, Cement-based solidification, Mathematical models, Model studies, Leaching, Industrial wastes.

A cement-based solidification process designed for hazardous sludge produced from the electroplating industry was evaluated. Four factors of sand/sediment (S/C) ratio, water/cement (W/C) ratio, amount of wet sludge and amount of precipitator were investigated in terms of leachability and compressive strength of the solidified materials. Results of triplicate tests and statistical analysis indicated that S/C ratio had the greatest effect on leaching of Cr(VI) while W/C ratio had the greatest effect on Zn and compressive strength of the solidified materials. An experimental model was developed to estimate leached material concentration and compressive strength at a given condition. Proper mixing criteria were also suggested for the use of the solidified mixture as construction materials. (Author's abstract)
W89-04417

METRO CHICAGO'S SLUDGE MANAGEMENT PLAN,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5D.
W89-04464

USE OF SLUDGE AND SULPHIDE TO REMOVE HEAVY METALS FROM SEWAGES BEFORE ACTIVATED SLUDGE TREATMENT,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 5D.
W89-04474

5F. Water Treatment and Quality Alteration

DEVELOPMENT OF METHODOLOGY FOR RETROFITTING WATER LIFELINES FOR IMPROVED SEISMIC RESISTANCE,
Environmental Quality Systems, Inc., Rockville, MD.
For primary bibliographic entry see Field 8G.
W89-03347

DATA-BASED WATER QUALITY INFORMATION SYSTEM,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
S. Campbell, and J. Finkeldey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-185 616. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/055, March 1988. 10p, 6 fig, 2 ref.

Descriptors: *Information storage and retrieval, *Water quality, *Databases, *Data collections, *Drinking water, Information exchange, Computers, Research.

Various research activities conducted by the Drinking Water Research Division (DWRD) of the EPA have resulted in the generation of extensive measurement data pertaining to water quality. This data is useful for investigating the performance and cost of drinking water treatment process systems. In order to perform multiple and/or extensive evaluations of this data, it was necessary to develop a computer based information retrieval system that would provide a consistent input data format and the capability to manage, access and report required information. The computer software resulting from this effort has provided DWRD with an effective method for analyzing large amounts of field-scale research data and providing ideas to upgrade water quality. (Author's abstract)
W89-03360

TREATMENT OF FARNHAM AND ASHLEY RESERVOIR WATER BY KROFTA SAND-FLOAT PROCESS SYSTEM--PROJECT SUMMARY,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-200647. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. KEC/01-84/1A, January 20, 1984. 40p, 3 fig, 11 tab.

Descriptors: *Flocculation, *Flotation, *Massachusetts, *Sand filters, *Water treatment, Farnham Reservoir, Ashley Reservoir, Sandfloat, Chemical precipitation, Chemical treatment, Bacteria, Iron, Manganese, Lead, Protozoa.

Raw water from Ashley and Farnham Reservoirs in Berkshire County, Massachusetts was treated by a newly developed Sandfloat process system consisting of chemical flocculation, dissolved air flotation and sand filtration. Turbidity, color, trihalomethane formation potential, UV absorbance, coliform bacteria, iron, manganese, lead and Giardia-cyst-sized particles (as measured by microscopic particle count) were significantly removed from the city of Pittsfield's raw water supply. The Sand-

float process easily met all the EPA and the Massachusetts Drinking Water Standards. Preliminary design criteria for coagulant feeding, chlorine feeding, flocculation detention time, flotation detention time, flotation surface loading, filter surface loading and sludge treatment are also developed for design of a full scale potable flotation-filtration plant. (Author's abstract)
W89-03368

REMOVING SYNTHETIC ORGANIC CHEMICALS FROM DRINKING WATER BY GRANULAR ACTIVATED CARBON: PERFORMANCE AND COST,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
B. W. Lykins, R. M. Clark, and J. Q. Adams.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-182118. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/046, March 1988. 8p, 2 fig, 2 tab, 7 ref.

Descriptors: *Drinking water, *Water treatment, *Organic compounds, *Granular activated carbon, Costs, Adsorption, Potable water, Water quality, Water analysis.

Granular activated carbon (GAC) has been shown to be an effective adsorbent for removing many of the synthetic organic compounds (SOCs) scheduled for regulation and to be an effective broad-spectrum adsorbent. EPA data demonstrates by field-scale contactors, pilot columns, and minicolumn, and pilot column studies are underway on others. The extent of SOC removal depends on several factors such as empty bed contact time (EBCT), type of GAC used, competition for adsorption sites from other organics, precursor material, etc. Each utility considering GAC for SOC control should evaluate their specific situation. This evaluation should include some method for predicting full-scale operation. (Lantz-PTT)
W89-03375

SMALL MUNICIPALITY USES CONTRACT SERVICES,
For primary bibliographic entry see Field 5D.
W89-03450

CLEAN WATER SUPPLY DEPENDS ON MANAGEMENT OF GROUNDWATER,
Greeley and Hansen, Chicago, IL.
For primary bibliographic entry see Field 5G.
W89-03492

POTENTIAL HEALTH RISK OF TRIHALOMETHANES IN DRINKING WATER: A PERSPECTIVE,
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W89-03524

PRICE OF CONFIDENCE: THE RATIONALITY OF RADIUM REMOVAL FROM DRINKING WATER,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Crawford-Brown.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 152-154.

Descriptors: *Cost-benefit analysis, *Water treatment, *Risks, *Costs, *Radium, *Radioisotopes, *Drinking water, Theoretical analysis.

Radium removal from drinking water, for the purpose of saving lives, is discussed. During the past several years, the U.S. Environmental Protection Agency has developed proposed regulatory limits for radium, uranium and radon in U.S. Public Drinking Water. These limits are based on an analysis of the risk imposed by radium in drinking water, and an assessment of the costs for removal to specified concentrations. Typical approaches to examining the rationality of such limits focus on the expectation value of the risk and the cost associated with potential actions. These approaches treat the risks as if they are known, and the costs as if they are to be measured against these known risks. In actuality, the savings in lives bought by any expenditure is uncertain. As a result, it cannot be claimed rationally that a given expenditure saves any given number of lives. Instead, it must be recognized that an expenditure produces a state of the environment characterized only by a potential for saving lives. In effect, the money has been spent to gain a degree of confidence that a given number of lives will be saved. The manner in which an expenditure for radium removal yields a rational basis for confidence in saving lives is explored. (See also W89-03595) (Author's abstract)
W89-03607

RECENT DEVELOPMENTS IN TECHNOLOGY FOR REMOVING RADIONUCLIDES FROM DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
T. J. Sorg.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 157-158.

Descriptors: *Radioisotopes, Drinking water, Water treatment, Radium, Radon, Uranium, Activated carbon, Aeration, Radioactive waste disposal.

Two treatment methods for the removal of radium, uranium and radon from drinking water are being applied to treat both community water supplies and individual home water supplies: (1) granular activated carbon, and (2) aeration. Concerns have been raised regarding external radiation from household granular activated carbon systems and the buildup of radionuclides within the carbon. Shielding devices are being examined to minimize the amount of radiation adjacent to these systems. Studies are also being conducted to determine the amount and location of the radon decay products. Aeration has also been found to be very effective for radon removal. Pilot plant tests have shown that bubble aeration, packed tower aeration and spray aeration are good, practical methods for radon removal, particularly for small communities. Radium, uranium and radon are all naturally occurring contaminants in groundwater. While the EPA drinking water regulations apply only to community water supply systems and not to individual home water supplies, concerns still exist for homeowners. To solve these problems, point-of-use/point-of-entry treatment systems are available to remove all three contaminants. A very important aspect of treatment is the removal of waste residuals from the treatment processes. Because these wastes contain radionuclides, concerns for their disposal have been raised by federal, state and local agencies. Several states have developed regulations for the disposal of radium sludges and brines and other states are considering similar action. (See also W89-03595) (Miller-PTT)
W89-03609

OZONE BY-PRODUCTS IN DRINKING WATER PRODUCED UNDER FULL SCALE TREATMENT CONDITIONS,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
W. H. Glaze, M. Koga, D. Cancilla, K. Wang, and C. H. Tate.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 382-385. 1 tab, 2 fig.

Descriptors: *Ozonation, *Water pollution sources, *Ozone, *Drinking water, *Water treatment, *Pretreatment of water, Flocculation, Filtration, Chlorination, Resins, Trihalomethanes, Hydrocarbons.

Ozone by-products produced under full scale treatment conditions of drinking water were investigated. The water was treated at different ozone doses or pre-chlorination, followed by flocculation, filtration, and chlorination. Ozonation decreased the trihalomethane and total organic halide levels of finished water as compared to pre-chlorination. Aldehydes isolated by closed loop stripping analysis and analyzed with gas chromatography/mass spectrometry increased after ozonation. Lowered ozone doses produced higher concentrations of aldehydes. Filtration lowers the level of these aldehydes; however, levels of aldehydes increased after final chlorination. A variety of fatty acids, aldehydes, and ketones were identified by XAD-4/8 resin accumulation. (See also W89-03595) (Author's abstract)
W89-03648

STUDY OF ORGANIC PEROXIDE PRODUCED FROM THE OZONATION OF HEXADEC-9-ENOIC ACID (HDA) IN WATER,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
W. H. Glaze, K. Wang, D. Cancilla, M. Koga, and Y. Zelicovitz.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 406-409. 3 fig, 6 ref.

Descriptors: *Water analysis, *Pollutant identification, *Organic compounds, *Ozonation, *Hydrogen peroxide, *Chromatography, *Water treatment, Drinking water, Water analysis.

The peroxidase/fluorescence method for the analysis of hydrogen peroxide has been extended to the determination of low levels of organic peroxides in water. Three organic peroxides were used to test the revised method: (1) 1-((1-hydroperoxycyclohexyl)-dioxy)-cyclohexanol, (2) t-butyl hydroperoxide, and (3) cumene hydroperoxide. A reverse phase high performance liquid chromatography procedure with enzyme mediated postcolumn derivatization and fluorescence detection has been developed for the simultaneous analysis of organic peroxides and H2O2. Under the most favorable conditions, the detection limits of the post-column method are 6.0 nanograms for H2O2, 0.15 micrograms for 1-((1-hydroperoxycyclohexyl)-dioxy)-cyclohexanol, 3.7 nanograms for t-butyl hydroperoxide, and 7.0 nanograms for cumene hydroperoxide. Detection limits may be enhanced by preadsorption of the organic peroxides on a mixed bed XAD 4/8 resin with methanol elution. The high performance liquid chromatography method was used to detect a metastable peroxide intermediate from the ozonation of hexadec-9-enoic acid in water. (See also W89-03595) (Author's abstract)
W89-03651

PROCEEDINGS OF THE ELEVENTH UNITED STATES/JAPAN CONFERENCE ON SEWAGE TREATMENT TECHNOLOGY.
For primary bibliographic entry see Field 5D.
W89-03657

REUSE OF TREATED WASTEWATER IN FUKUOKA CITY,
Fukuoka City Sewage Works Bureau (Japan). Planning Div.
For primary bibliographic entry see Field 5D.
W89-03664

PROBLEMS IN MODELLING AND CONTROLLING A WATER CLARIFICATION PROCESS,
Sunderland Polytechnic (England). Dept. of Electrical, Electronic and Control Engineering.
A. R. Boucher, and C. S. Cox.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 283-288, 5 fig, 6 ref.

Descriptors: *Systems analysis, *Clarification, *Water treatment, *Model studies, *Process control, Rivers, Coagulation, Sludge, Mathematical

models, Water quality, Water supply, Potable water, Cost analysis.

The practical problems in modeling a water clarification process are described and the anticipated problems in designing the control system are discussed. The process of producing a potable water supply involves clarification, disinfection, pH adjustment, filtration, taste and odor removal. Abstraction from a river source, rather than a reservoir, introduces its own family of problems since because no natural settlement has occurred the quality of the raw water entering the works tends to be extremely variable. Because of the large variations in the quality of the input raw water and the possibility of a rapid deterioration, the tendency is to introduce a considerable safety margin into the clarification process by overdosing the coagulating chemicals. Overdosing does not in general adversely affect the final product, the surplus unactivated chemicals merely being precipitated to leave the plant as sludge. Since at present no policy relating to chemical recovery from the sludge is in operation, this practice is obviously inefficient and uneconomic. Another 'side effect' of overdosing is an adverse effect on the use of conventional system identification strategies which are being tried to obtain a mathematical model of the process. Such a model is a desirable first step in the design of an automatic control strategy. This paper highlights some of the problems encountered to date when trying to model and control a water clarification process. (See also W89-03679) (Author's abstract)
W89-03707

LABORATORY SIMULATION AND OPTIMIZATION OF WATER TREATMENT PROCESSES -- DEMONSTRATION PROJECTS.
Lenox Inst. for Research, Inc., MA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168414. Price codes: A04 in paper copy, A01 in microfiche. Technical Manual No. LIR/07-86/183, July 23, 1986. 54p. Edited by Lawrence K. Wang, Mu Hao Sung Wang, Domenic J. Pulice, Cheng-nan Weng, and Donald L. Hoven.

Descriptors: *Simulation analysis, *Water treatment, *Wastewater treatment, Case studies, Filtration, Ozonation, Cooling tower, Water quality.

A case history is presented for a four-year pilot plant study prior to design and construction of the full scale water treatment plant additions of Haworth Filtration Plant in New Jersey. The results of the pilot plant study show that chemical coagulation, ozonation, flotation/skimming, and sand filtration can be used successfully to treat the Oradell Reservoir water. The new treatment process will produce a finished water with less dissolved solids and improved taste and odor. There will be a substantial reduction in the usage of alum, chlorine, and caustic soda. In addition, the amount of sludge produced in the process will be substantially reduced and the characteristics of the sludge are such that its disposal will be less costly. A second case history of laboratory experimentation is presented to demonstrate that the effectiveness of ozonation of recycled water used in dissolved air flotation treatment of cooling tower water can be optimized. Major scaling factors were evaluated along with reduction of microbiological contamination. While dissolved air flotation technology works adequately for removal of undesirable constituents, optimum removals are obtained when ozonation of recycle water is included in the process. (See W89-03728 thru W89-03729) (Author's abstract)
W89-03727

OZONATION - AN ECONOMIC CHOICE FOR WATER TREATMENT,
Buck, Siefert and Jost, Inc., Param[illegible]
C. N. Weng, D. L. Hoven, and B. J. [illegible]wartz.
IN: Laboratory Simulation and Optimization of Water Treatment Processes -- Demonstration Projects. Technical Manual No. LIR/07-86/183, July 23, 1986. p 1-34, 6 fig, 8 tab, 1 ref.

Descriptors: *Water treatment, *Ozonation, *Hackensack, *New Jersey, Taste, Odor control, Filtration, Ozone, Polymers, Water quality.

Hackensack Water Company (HWC) is an investor-owned water company serving approximately 800,000 people in Northern New Jersey. The Company has two water treatment plants, the New Milford Purification Plant (NMPP) and the Haworth Filtration Plant (HFP). Consulting Engineers have prepared a preliminary design memorandum for HWC covering the proposed expansion of the HFP from a present maximum capacity of 52 mgd to 160 mgd. It stated that there was a possibility of using ozonation as a pretreatment method followed by direct filtration thereby eliminating the need for settling basins. In order to verify that this process could be successfully used on HWC waters, pilot plant studies have been conducted. The following conclusions have been drawn: (1) coagulation, ozonation, and direct filtration can be used successfully to treat the Oradell Reservoir water; (2) Up to certain limits, increasing alum and/or polymer dosages results in better color and turbidity, less particulate iron and manganese and lower standard plate count in the filtered water; (3) Increasing the applied ozone dosage results in better color and turbidity, lower standard plate count and less organic concentration in the filtered water; (4) Ozonation converts the musty or grassy odor of the raw water into a nonobjectionable sweet odor in the filter effluent; (5) Varying the ozone contact time from 4.1 to 24.8 min has no appreciable effect on the water quality; (6) The performance tests show that dual media is the most beneficial type of filter media to be used; (7) In order to maintain the autocatalytic reaction for the removal of soluble Mn, the aged media in the filter should be regenerated when the sorption capacity of the surfaces of the manganese oxide coating has been exhausted; (8) It is not feasible to regenerate the filter media by feeding potassium permanganate solution continuously to the filter influent; (9) Because the pH of the Haworth Ozonation Plant effluent is already high, no pH adjustment is required; and (10) The proposed treatment scheme for the expansion of the HFP will produce a finished water with lower concentrations of dissolved organics, dissolved solids, and TTHM and improved taste and odor. The sludge production of the new plant will be substantially lower than the present amount. (See also W89-03727) (Lantz-PTT)
W89-03728

TREATMENT OF COOLING TOWER WATER BY DISSOLVED AIR-OZONE FLOTATION,
Lenox Inst. for Research, Inc., MA.
M. Krofta, and L. K. Wang.
IN: Laboratory Simulation and Optimization of Water Treatment Processes -- Demonstration Projects. Technical Manual No. LIR/07-86/183, July 23, 1986. p 41-54, 1 fig, 3 tab, 19 ref.

Descriptors: *Cooling towers, *Ozonation, *Water reuse, *Flotation, Ozone, Algae, Metals, Iron, Copper, Bacteria, Water quality.

Pretreatment and ozonation of cooling tower water have been investigated; specifically the effect of ozonation on recycle water and the relative improvement of overall water quality after flotation treatment. Bacterial analysis indicates that the combined ozonation and dissolved air flotation reduces the coliform count. Metals measured were also decreased by flotation and ozonation. The oxidation of iron ions by ozonation of the recycle water facilitated removal by the flotation process. This has proven to be effective in other conventional treatment systems (using chemical oxidant such as chlorine). Copper levels were lower following the treatment. The removal of constituents was also apparent in the recycle water improving its quality after ozonation and facilitating a more effective flotation process. Water quality of the recycle water was measured after ozonation in separate analyses. The ozonation of recycle water did not change the degree of hardness of the recycle water indicating that hardness removal is probably due to the physical treatment for solid removal by flotation and filtration. Apparently the removal of hardness is due to the physical treatment but enhanced by ozonation of the recycle water. An ozone residual of 0.33 mg/L was measured indicating ozone demand of 3.00 mg/L (ozone dosage was 3.33 mg/L). (See also W89-03727) (Lantz-PTT)
W89-03729

WINTER OPERATION OF THE FIRST UNITED STATES FLOTATION INSTALLATION: WATER TREATMENT PLANTS, CITY OF PITTSFIELD, MASSACHUSETTS,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-180336. Price codes: A03 in paper copy, A01 in microfiche. Presented at the American Water Works Association Annual Conference, Kansas City, MO, June 15, 1987. (1987). 20p, 2 fig, 3 tab, 23 ref.

Descriptors: *Flotation, *Water treatment, *Case studies, *Pittsfield, *Massachusetts, Sandfloat, Flocculation, Filtration, Chemical treatment, Water quality control.

The City of Pittsfield Water Treatment System, Massachusetts, is equipped with six Sandfloat units (2 units at Ashley Plant, and 4 units at Cleveland Plant) each having a capacity of 6.25 MGD. Sandfloat is a compact plant consisting of one unit of flocculation, dissolved air flotation and sand filtration. The performance of Sandfloat Nos. 1 and 2 at Ashley Plant in the period Dec. 4, 1986 to March 20, 1987, is documented in detail. The technical feasibilities of Sandfloat and chemical treatment costs are presented. It is concluded that the mixture of 28% Ashley raw water and 72% Farnham raw water, having moderate alkalinity and low temperature in Winter 1987, can be treated satisfactorily by Sandfloat (Type 49; Diameter 49 ft; depth 6 ft) at 5.5-5.8 MGD per unit using the chemical combination of sodium aluminate, polymer 1849A and alum. If 100% Farnham raw water with extremely low alkalinity and low pH is to be treated, Ultrion 8157, sodium aluminate and polymer 1849A will be the best chemical combination for proper clarification. The Sandfloat effluent meets the effluent quality criteria specified in the 'Plan and Specification of Pittsfield Water Treatment Facilities'. (Author's abstract)
W89-03732

DISSOLVED AIR FLOTATION PROCESSES,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W89-03735

RESEARCH ACTIVITIES IN DRINKING WATER TECHNOLOGY: A PROGRESS REPORT,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-171236. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/036, February 1988. 39p, 16 fig, 8 tab, 15 ref.

Descriptors: *Drinking water, *Research priorities, *Water treatment, Granular activated carbon, Ozonation, Oxidation, Organic compounds, Reverse osmosis, Radon, Ozone, Filtration.

The Safe Drinking Water Act and its Amendments (SDWAA) have given EPA an aggressive standard setting agenda. This agenda, if carried out fully, will impact on water utilities in the U.S. EPA's Drinking Water Research Division (DWRD) is responsible for evaluating technologies for meeting the maximum contaminant levels to be established under SDWAA. Work is actively being conducted in the following areas: identification and control of disinfection by-products; use of microcolumn and adsorption modeling to predict usage rates for granular activated carbon (GAC); cost of GAC systems; use of ozone and ozone/H2O2 for oxidation of organics; reverse osmosis; radon removal; calculation of column effluent concentra-

tion times time (C x t) values; and control of water quality in distribution systems. Among the most promising technologies for organic removal are ozone, ozone in combination with other oxidants, and reverse osmosis (ultrafiltration). Work will also continue in examining various techniques for disinfection of pathogenic organisms. (Author's abstract)
W89-03738

COMMUNICATION ON SANITARY ENGINEERING AND WATER MANAGEMENT: GRAVEL-BED FLOCCULATION,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
K. K. Mishra, and A. N. Van Breemen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-185988. Price codes: E09 in paper copy, A01 in microfiche. October 1987. 231p, 11 fig, 29 tab, 107 ref, 2 append.

Descriptors: *Filtration, *Water treatment, *Gravel, *Flocculation, Alum, Turbidity, Polyaluminum chloride, Drinking water, Head loss.

Important parameters influencing the degree of particulate removal from low turbidity water were investigated in a configuration that included flocculation through a 'Gravel-bed' followed by direct filtration. The effects of selected initial conditions and operating parameters on the performance of the flocculator were evaluated using laboratory tap water alone and laboratory tap water with low and high concentrations of calcite suspension up to a turbidity of 100 nephelometric turbidity units. Polyaluminum chloride (PAC), was used in place of alum, since the alum was found to be not so effective at low temperatures. The effects of specific Al(3+) doses selected for evaluation on the process performance were much greater than the effects of initial selected water quality conditions or operational parameters. Low flocculator approach velocities up to 10 m/hr produced bigger size flocs which resulted in high quality filter effluent but high filter head loss. On the other hand, high flocculator approach velocity above 12.5 m/hr produced finer flocs resulting in inferior filtrate quality but low filter head loss. A dose of 0.5 mg/L of Al(3+) and 10.0 m/hr of flocculator approach velocity (with 10.0 m/hr of filtration rate) were the optimum values at which the flocculator functioned effectively and efficiently even beyond 27 hours of run. (Lantz-PTT)
W89-03744

WATER MANAGEMENT AND PROTECTION IN OPENCAST MINING REGIONS AND UTILIZATION OF MINE WATER.
For primary bibliographic entry see Field 4B.
W89-03752

ROLE OF GRAVEL-PIT LAKES IN THE REMOVAL OF NITRATE FROM PHREATIC AQUIFERS OF THE GARONNE VALLEY: AN ATTEMPT AT AN EVALUATION (ROLE DES LACS DE GRAVIERES DANS LA DIMINUTION DES TENEURS EN NITRATES DES AQUIFERES ALLUVIAUX DE LA VALLEE DE LA GARONNE: ESSAI DE QUANTIFICATION).
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5B.
W89-03844

BIOLOGICAL PROCESSES IN DRINKING WATER TREATMENT,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Engineering Science.
E. J. Bouwer, and P. B. Crowe.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 82-93, September 1988. 4 tab, 116 ref.

Descriptors: *Water treatment, *Biological treatment, *Drinking water, *Biological oxidation, Organic carbon, Municipal water, Microbial degradation, Chlorination.

Biological processes have the potential to remove pollutants that may be ineffectively removed by conventional treatment, such as biodegradable organics, synthetic organic compounds, ammonia, nitrate, iron, and manganese. Biooxidation of organic matter and ammonia decreases available substrates for microbial regrowth in distribution systems, reduces tastes and odors, and decreases the amount of precursor available to form disinfection by-products. Biological removal of certain contaminants could extend the service time or capacity of subsequent physicochemical processes. In US water treatment, the practice is often to impair or preclude development of biological activity by prechlorination, rigorous scouring of filter media, and frequent backwashing of granular activated carbon. Practical experience in Europe with media containing microbial activity has been favorable. (Author's abstract)
W89-03880

METHODS OF MEASURING DISINFECTANT RESIDUALS,
Miami Univ., Oxford, OH. Hughes Labs.
G. Gordon, W. J. Cooper, R. G. Rice, and G. E. Pacey.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 94-108, September 1988. 2 tab, 53 ref.

Descriptors: *Water treatment, *Disinfection, *Residual chlorine, *Test procedures, *Ozone, *Chemical analysis, Reviews, Measuring instruments, Chlorine, Spectrophotometry.

The analytical methods currently used to measure disinfectant residuals, including free chlorine (along with various chloramines), combined chlorine, chlorine dioxide, chlorite ion, chlorate ion, and ozone, are critically evaluated. All methods and recommendations are summarized in a table for easy reference. In comparing all the methods, the authors found that none came close to the ideal standard. Continued development of the various selective methods, however will bring them closer to the ideal. For chlorine determination, the amperometric titration techniques will remain the laboratory standard for comparisons of accuracy. Of the three common colorimetric procedures, DPD (N,N-diethyl-p-phenylenediamine) is by far the most commonly used. The best choice for measuring chlorite is either the amperometric method or a UV-based method. Only the UV spectrophotometric method can be recommended for accurate determinations of gas-phase ozone. For accurate determination of ozone in the aqueous phase, indigo trisulfonate and arsenic(III) direct oxidation are acceptable methods. The most important aspects of any potential new or improved analytical method for ozone will be speed of analysis and selectivity of the detection system for ozone. (Ver-Nooy-PTT)
W89-03881

BIOLOGICAL NITRIFICATION OF COVERED RESERVOIRS CONTAINING CHLORAMINATED WATER,
Southern California Metropolitan Water District, La Verne.
R. L. Wolfe, E. G. Means, M. K. Davis, and S. E. Barrett.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 109-114, September 1988. 2 fig, 2 tab, 39 ref.

Descriptors: *Water pollution sources, *Water quality management, *Water treatment, *Chlorinated water, *Nitrification, *Reservoirs, *Nitrogen fixing bacteria, Covered reservoirs, Chloraminated water, Disinfection.

Nitrification occurred in two covered finished-water reservoirs in Southern California following a change from free chlorine to chloramine disinfection. The proliferation of autotrophic ammonia-oxidizing bacteria was suspected to be the cause. Adverse water quality effects caused by the nitrification episodes included a rapid decline in the total chlorine and total ammonia-nitrogen residuals and elevated levels of nitrite and heterotrophic plate count bacteria. As a result, the reservoirs were taken out of service and breakpoint-chlorinated. The conditions leading to the development of nitrification in reservoirs containing chloraminated water are examined, along with the measures that can be used to control the process. (Author's abstract)
W89-03882

RESISTANCE OF BACTERIAL SUBPOPULATIONS TO DISINFECTION BY CHLORINE DIOXIDE,
Aquateam-Norwegian Water Technology Centre of Oslo (Norway).
J. D. Berg, J. C. Hoff, P. V. Roberts, and A. Matin.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 115-119, September 1988. 5 fig, 2 tab, 38 ref.

Descriptors: *Water treatment, *Bacteria, *Bactericides, *Chlorine, *Resistance, *Disinfection, *Chlorine dioxide, Residual chlorine, Coliforms, Chemical treatment, Microbiological studies.

Deviations from first-order inactivation of microorganisms are commonly observed during disinfection. These have been attributed to aggregation, decreasing concentration of disinfectant, or biological heterogeneity. The phenomenon, however, has not been properly investigated. During this study, chemostat-grown and batch-grown populations Legionella pneumophila and Escherichia coli were dosed with chlorine dioxide (ClO_2) to achieve an initial concentration of 0.75 mg/L. Results indicate that a resistant fraction of cells survives in the absence of aggregation and with a constant ClO_2 residual. The resistance is a phenotypic characteristic that can be manipulated by altering the antecedent growth environment. Growth rate and temperature were important determinants of the size of the recalcitrant population. (Author's abstract)
W89-03883

CAN PUBLIC NOTIFICATION WORK FOR YOU,
For primary bibliographic entry see Field 6E.
W89-03885

MANAGEMENT ASPECTS OF PUBLIC NOTIFICATION REQUIREMENTS,
Ann Arbor, MI.
For primary bibliographic entry see Field 6E.
W89-03886

EFFECTS OF OZONATION ON TASTES AND ODORS,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
C. Anselme, I. H. Suffet, and J. Mallevialle.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 45-51, October 1988. 11 fig, 6 tab, 32 ref.

Descriptors: *Ozonation, *Taste, *Odors, *Organoleptic properties, *Water quality standards, *Water treatment, Chemical treatment, Potable water, Case studies, Literature review.

Ozonation was effective for removing musty, earthy, fishy, and muddy tastes and odors from water that had been chlorinated, coagulated, and sand filtered. Astringent and plastic tastes were not significantly removed. The ozonation process was found to be responsible for the development of high-intensity fruity odors. A combination of statistical and chemical analyses was used to help determine the source and evolution of fruity tastes and odors in potable water treatment. A short literature review is included as well as a case history of the use of the flavor profile analysis (FPA) method to aid in the evaluation of the effects of ozonation at a water treatment plant. A correlation between the FPA method and chemical analysis helps to show how ozone changes taste and odor compounds. Correlations for fruity tastes and odors were confirmed by developing FPA panel dose-response curves. (Author's abstract)
W89-03888

REVIEW OF SOLID-SOLUTION INTERACTIONS AND IMPLICATIONS FOR THE CONTROL OF TRACE INORGANIC MATERIALS IN WATER TREATMENT.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 56-64, October 1988. 8 fig, 6 tab, 74 ref.

Descriptors: *Reviews, *Solids contact processes, *Chemical reactions, *Water treatment, *Heavy metals, *Water pollution treatment, *Inorganic compounds, Trace levels, Particulate matter, Corrosion.

Chemical and physical phenomena important for determining the partitioning of inorganic contaminants between solution phase and particulate phases are reviewed. Important considerations used to understand and manipulate conventional treatment processes to enhance the removal of inorganic contaminants and to inhibit the release of trace inorganic contaminants resulting from corrosion processesare illustrated. Simple thermodynamic models are used to predict species distribution for selected inorganic contaminants and to compare the predictions of the model with experimental and field observations. Further research is required to refine the thermodynamic models, to tailor them to water treatment applications, and to provide additional field data that can be used for improvement of the models and to demonstrate their utility. (Vernooy-PTT)
W89-03890

FLOATING RESERVOIR COVER CONTROLS ALGAE GROWTH, ALLOWS LOWERED THMS,
C. Griffith.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 66, 68-69, October 1988.

Descriptors: *Reservoirs, *Impervious membranes, *Reservoir management, *Algae control, *Water treatment, *Trihalomethanes, *Chlorination, Reservoir storage, Cost analysis, California.

Installing a floating cover on a 29-acre reservoir allowed the Metropolitan Water District of Southern California (MWD) to adopt a new chlorination procedure that reduced trihalomethane (THM) levels without increasing algae growth. The cover, a floating membrane based on a synthetic rubber, is the second largest floating cover in the world. To reduce the THM level chlorination by free chlorine was replaced by the relatively siower process using ammonium chloride. Since the breakdown of ammonium chloride from the slower ammonium chloride process would leave the reservoir supplies rich in a ammonia, a powerful algae nutrient, a reservoir cover was needed to eliminate light and prevent algae growth. Installation, including a special float system for a tower in the reservoir and inflation testing is detailed. In addition to allowing the MWD to supply its customers with water containing THMs at a concentration well below federal standards, the cover allows the district to operate the reservoir at higher water levels. Algae control afforded by the cover enabled operation at elevations up to 325 ft (up from 300 ft). Increased operations levels require less pumping energy which benefits the water agencies buying water from MWD. (VerNooy-PTT)
W89-03891

OZONE GAS SCRUBBING FOR AIR-OPERATED OZONE GENERATION SYSTEMS,
Stadwerke Karlsruhe (Germany, F.R.). Versorgungsbetriebe.
D. Maier, R. Beran, and R. Schick.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 241-253, 1988. 11 fig, 10 ref.

Descriptors: *Nitrogen compounds, *Ozone, *Water treatment, *Ozonation, Drinking water, Nitric acid, Disinfection, Corrosion, Steel, Oxidation, Gas scrubbing.

In laboratory testing and semi-technical tests it was found that the removal of the dinitrogen pentoxide (N2O5) originating as a by-product in ozone generation from air can be realized from a chemical point of view by the use of gas scrubbing with treated drinking water, and forming nitric acid. With a specially designed gas scrubber it is possible to retain from the treated drinking water at the Bodensee Wasserversorgung approximately 11,000 liters of 10% nitric acid, and at the same time reduce the chloropicrin (trichloronitromethane) concentration by 30%. Extensive analytical efforts showed that as preliminary substances of chloropicrin formation, resulting from the ozonation of water from the Lake of Constance in combination with the nitrating effect of N2O5, or already contained therein, such substances as acetamide, hydroxynitrotoluene and hydroxynitroxylene are formed. The material used in the scrubber (stainless steel DIN 1.4571) will be attacked under conditions such as these. The method described for the removal of the dinitrogen pentoxide originating during ozone production from air will be especially useful for waterworks having higher chloropicrin concentrations due to greater pollution of the raw water with nitrifiable precursors. (Author's abstract)
W89-03908

WATER QUALITY IMPROVEMENTS WITH THE USE OF OZONE AT THE LOS ANGELES WATER TREATMENT PLANT,
Los Angeles City Dept. of Water and Power, CA.
D. L. Georgeson, and A. A. Karimi.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 255-276, 1988. 13 fig, 5 tab, 20 ref.

Descriptors: *Ozone, *Water treatment, *Los Angeles, *Ozonation, *Water treatment facilities, Pretreatment of water, Bactericides, Viricides, Chlorination, California, Disinfection, Operating costs, Cost analysis, Turbidity, Odors, Color, Taste.

At 600 mgd (2,270 ML/day), the recently completed Los Angeles Aqueduct Filtration Plant (LAAFP) is one of the world's largest water treatment facilities utilizing ozone for pretreatment. The treatment process provides effective removal of turbidity at high filtration rates of up to 13.5 gpm/sq ft (33 m/hr), resulting in a lower effluent water turbidity than predicted during the pilot plant testing. Preozonation, followed by direct filtration in full-scale operation, results in about 49% reduction of trihalomethane formation potential. Up to 50% reduction in coagulant (i.e., cationic polymer) requirements compared to prechlorination, are found, resulting in reduction of treatment cost and the quantities of sludge produced. Better viricidal and bactericidal effects were observed by ozone treatment than by chlorine. Ozone is known to be a more powerful virucide and bactericide than chlorine. Ozone treatment reduces the chlorine demand, resulting in lower chlorine requirements in the final disinfection process. Under the optimized full-scale operation, preozonation has resulted in significantly reduced trihalomethane levels and very low effluent turbidity with low operating costs. (Geiger-PTT)
W89-03909

OZONE CONSUMPTION IN NATURAL WATERS: EFFECTS OF BACKGROUND ORGANIC MATTER, PH AND CARBONATE SPECIES,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. Yurteri, and M. D. Gurol.
Ozone Science and Engineering OZSEDS, Vol. 10, No. 3, p 277-290, 1988. 3 fig, 1 tab, 22 ref. U. S. EPA Cooperative agreement R-811128-01.

Descriptors: *Ozone, *Organic matter, *Hydrogen ion concentration, *Water treatment, *Disinfection, *Ozonation, Carbonates, Water quality, Natural waters, Raw water, Models, Alkalinity, Kinetics, Organic carbon.

In natural waters, where organic and inorganic impurities interact not only with ozone (O3) but also with hydroxyl ion (OH), ozone consumption can be described by an overall rate expression which is first order with respect to the concentration of O3. The apparent rate constant for this overall expression is called the specific ozone utilization rate, (w). As a key process parameter, the w value of a raw water is a function of its pH and chemical composition. In groundwaters, for instance, the value for w typically is low (< or = 5/hr), whereas w values of contaminated surface waters may exceed 50/hr. An analysis was made of the dependency of w on raw water quality, and correlations were made of w with the pH, alkalinity, and total organic carbon (TOC) of the water matrix. The developed model can predict w within +/- 25%, and it is particularly useful for obtaining preliminary estimates of w (or ozone lifetimes) in raw drinking waters which are not heavily contaminated with man-made pollutants. It is theorized that the predictive power of the model can be improved by introducing additional independent variables, such as Fe(2+) and NO3(-) concentrations, or by replacing the TOC content with another indicator which can differentiate the effect of synthetic organic compounds from that of naturally occurring background organic matter. (Author's abstract)
W89-03910

APPLICATIONS OF OZONE IN JAPAN FOR WATER AND WASTEWATER TREATMENT,
Ebara Research Co. Ltd., Fujisawa (Japan).
For primary bibliographic entry see Field 5D.
W89-03912

COMPARISON OF OZONE AND OXYGEN MASS TRANSFER IN A LABORATORY AND PILOT PLANT OPERATION,
Energoprojekt, Belgrade (Yugoslavia). Hidroinzenjering.
For primary bibliographic entry see Field 5D.
W89-03913

EVALUATION OF ULTRAVIOLET LIGHT FOR DISINFECTION OF HOSPITAL WATER CONTAMINATED WITH LEGIONELLA,
Virginia Univ., Charlottesville. School of Medicine.
B. M. Farr, J. C. Gratz, J. C. Tartaglino, S. I. Getchell-White, and D. H. M. Groschell.
Lancet LANAA1, Vol. 2, No 8612, p 669-671, September 1988. 1 tab, 28 ref.

Descriptors: *Ultraviolet radiation, *Water treatment, *Disinfection, *Legionella, Epidemics, Filtration, Hospitals, Drinking water, Bacteria.

An epidemic of nosocomial Legionella micdadei pneumonia occurred among renal transplant patients in the University of Virginia hospital between 1978 and 1982. Although no further cases were diagnosed after 1982, filters and ultraviolet light (UVL) fittings were installed in 1985 as an attempt to disinfect water piped to rooms of transplant patients, because of concern about persistence of L. micdadei in hospital water. Water samples were obtained from eight UVL-treated rooms and eight control rooms. Twenty-six of ninety-five control samples were culture positive for L. micdadei compared with 0 of 71 samples of filtered, UVL-treated water ($p < 0.0001$, Fisher's exact test). After the UVL fitting and filter had been bypassed because of a leak, 9 of 33 samples from the UVL rooms were positive ($p < 0.0001$). These data suggest that UVL treatment may be useful in continuous disinfection of water in the hospital rooms of high-risk patients. (Author's abstract)
W89-03934

IMPACT OF BLEACHED KRAFT MILL EFFLUENTS ON DRINKING WATER QUALITY,
Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research.
For primary bibliographic entry see Field 5C.
W89-03959

METHOD FOR EVALUATING MUTAGENICITY OF WATER: II. CONDITIONS FOR APPLYING NEW SAMPLF PREPARATION METHOD TO THE AMES TEST,
Yokohama National Univ. (Japan).
For primary bibliographic entry see Field 5A.

W89-03964

CONTINUOUS POLIOVIRUS DETECTION IN WATER SUPPLY DISTRIBUTION NETWORKS (DETECTION EN CONTINU DU POLIOVIRUS DANS DES EAUX DE DISTRIBUTION PUBLIQUE),
Service de Controle des Eaux de la Ville de Paris (France).
P. Vilagines, B. Sarrette, and R. Vilagines.
Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT, Vol. 307, No. 4, p 171-176, June 28, 1988. 2 fig, 1 tab, 11 ref. English summary.

Descriptors: *Viruses, *Water conveyance, *Disinfection, *Filtration, *Monitoring, Water treatment, Pipes, Water transport, Adsorption, Hydrogen ion concentration, Reagents, Sampling.

The effectiveness of glass wool as an adsorbent for poliovirus in water at neutral pH was investigated. Purified poliovirus type 1 was seeded in ultrapure water or tap water at pH 3 through 9 and filtered at 150 ml/hr through glass wool at a density of 0.4 g/cu cm. Virus fixation occurred in either type of water at low pH but decreased rapidly in ultrapure water at higher pH. In tap water, virus fixation is never lower than 79% even at alkaline pH, indicating the influence of minerals; further study showed that salts such as magnesium or calcium chlorides enhance virus adsorption in ultrapure water (pH 7.8). Experiments with buffers suggest that hydrophobic interactions occur between glass wool and the virus. It is concluded that glass wool can adsorb viruses in a wide pH range without any modification of the sample examined, permitting continuous analysis of the water sample at any point in the water network as long as a dechlorination system is inserted prior to the adsorbent cartridge. (Author's abstract)
W89-03988

FORMATION OF CHLORINATED AND BROMINATED ARTIFACTS DURING EXTRACTION OF DRINKING WATER WITH DICHLOROMETHANE,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5A.
W89-04000

CHLORELLA VIRUSES ISOLATED IN CHINA,
Nebraska Univ.-Lincoln. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2H.
W89-04001

RISK-BASED SELECTION OF MONITORING WELLS FOR ASSESSMENT OF AGRICULTURAL CHEMICAL CONTAMINATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
T. D. Scheibe, and D. P. Lettenmaier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB89 102248/AS. Price codes: A09 in paper copy, A01 in microfiche. Water Resources Series, Technical Report No. 101, Project Completion Report. April 1986. 177p, 9 fig, 7 tab, 32 ref, 4 append. Contract No. 14-08-0001-G1051. Project No. USGS G1051-07.

Descriptors: *Agricultural chemicals, *Groundwater pollution, *Monitoring, *Pollutant identification, Potable water supply, Drinking water, Public health, Ethylene dibromide, Sampling assessment, Monitoring wells, Washington, Whatcom County.

Public health agencies that are charged with assuring the safety of potable water supplies have long had well monitoring programs. Usually, sampling has been restricted to indicators of bacterial contamination. Current concerns about the health effects of agricultural chemicals have created a dilemma, since sampling costs are much higher than for bacteriological assessments. Because of the high cost of sampling, it is essential to sample those wells that are most susceptible to contamination, while protecting against incorrect prior assumptions about contamination risk. The monitoring o. ethylene dibromide (EDB), a highly toxic soil fumigant whose registration was suspended in 1983, is a useful case study in the design of a monitoring program for agricultural drinking water contamination. A three-tier strategy for assessing EDB contamination risk is proposed. At the first level, a determination is made of data needs and availability, problem objectives are defined, and the appropriate scope of the monitoring program is established. At the second level, a prioritization of wells within the study area is developed based on estimated risks. At the third level specific wells to be sampled are identified based on an objective of minimizing the aggregate health risk. The procedure has been implemented for interactive decision making using a microcomputer-based geographic information system approach. The evaluation of EDB contamination of domestic wells in Whatcom County, Washington is used as a demonstration study. (USGS)
W89-04127

STUDIES ON THE STABILITY OF N-CHLORO-AMINOACIDS: DECOMPOSITION OF N-CHLORO-L-SERINE,
Santiago Univ. (Spain). Dept. de Quimica Fisica.
J. M. Antelo, F. Arce, J. G. Fernandez, J. Franco, and P. Rodriguez.
Environmental Technology Letters ETLEDB, Vol. 9, No. 7, p 589-598, July 1988. 7 fig, 3 tab, 12 ref.

Descriptors: *Water pollution sources, *Disinfection, *Chlorination, *Wastewater treatment, *Chemical analysis, *Toxicity, N-chloro-aminoacids, Decomposition, Stability, Carcinogenesis, Mutagenesis, Water treatment.

The use of chlorine and its derivatives as disinfectants in both natural waters and wastewater have their drawbacks. Chlorating agents oxidize amino acids, which abound in these waters, to form chloroaminoacids. N-chloro derivatives have been studied for their carcinogenic and mutagenic effects as well as their possible toxic effects on aquatic ecosystems. Since the effects may depend on the stability of the N-chloro-aminoacids, the decomposition of N-chloro-L-serine was examined. Over the range pH 6-9 the rate of decomposition of N-chloro-L-serine is independent of ionic strength, pH, and its own concentration. The average rate constant at 25 C is 0.0178/min (a mean half life of 39 minutes). (Brock-PTT)
W89-04396

DENITRIFICATION IN-SITU OF GROUNDWATERS WITH SOLID CARBON MATTER,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
F. Boussaid, G. Martin, J. Morvan, J. J. Collin, and A. Landreau.
Environmental Technology Letters ETLEDB, Vol. 9, No. 8, p 803-816, August 1988. 6 fig, 6 tab, 8 ref.

Descriptors: *Water treatment, *Nitrate removal, *Denitrification, *Drinking water, In situ treatment, Aquifers, Nitrites, Microorganims, Organic matter.

A denitrification process for in-situ water treatment is proposed. The system has a drilling from which water is partly pumped out and distributed, the other part is passed through reactors filled with a mixture of straw and maerl and then reinjected into aquifers through the soil. Five series of in-situ experiments have been made. A reduction of the nitrates in aquifers by 10 to 20 mg/L has taken place very rapidly. The water exiting the reactors contains organic matter, nitrite and microorganisms but is completely purified by flowing through the soil. The drilling water has a chemical and biological quality compatible with drinking water standards. (Author's abstract)
W89-04410

ROLE OF STRATEGIES IN THE DEVELOPMENT OF LARGE SEWAGE TREATMENT WORKS,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5D.
W89-04463

5G. Water Quality Control

COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM WORK PLAN FOR FISCAL YEAR 1988.
Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife.
For primary bibliographic entry see Field 6A.
W89-03335

WATER QUALITY CRITERIA FOR 2,4,6-TRINITROTOLUENE (TNT),
Martin Marietta Energy Systems, Inc., Oak Ridge, TN.
M. G. Ryon.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A188 951. Price codes: A06 in paper copy, A01 in microfiche. Report No. AD-ORNL-6304, August 1987. 135p, 3 fig, 31 tab, 155 ref, 2 append. U.S. Army Project 84PP4845.

Descriptors: *Water quality standards, *Regulations, *Trinitrotoluene, Toxicity, Fish, Macroinvertebrates, Larvae, Trout, Aquatic environment, Water quality.

The persistence of trinitrotoluene (TNT) in the environment when dissolved in surface water is very limited; biological degradation occurs slowly, while photolytic degradation occurs faster with half-lives for TNT exposed to natural sunlight of 3 to 22 hrs. As a solid or dissolved in groundwater, TNT can remain undecomposed for long periods of time. Studies of the acute toxicity of TNT to aquatic organisms indicate that LC50 values range from 5.2 to 27.0 mg/L for invertebrates in 48 hr static tests, and from 2.0 to 3.7 mg/L for fish in 96 hr flow-through tests. Chronic studies of early life stages of fish in flow-through conditions indicated egg hatching and fry survival were decreased at levels of 0.84 to 1.35 mg/L in three species exposed for 30 days. In 60-day studies of trout eggs and fry, levels of 0.24 to 1.69 mg/L reduced fry survival. A several-generations study of fathead minnows, conducted under flow-through conditions at levels of 0.04 to 1.21 mg/L TNT, indicated significant effects and affected the later generations more severely than the parent generation. Estimates of bioconcentration factors for TNT were not very reliable, but general consensus was that TNT does not highly bioconcentrate. Drinking water limits of 0.03 to 0.05 mg/L were recommended by the U.S. Army and Navy. Previous calculations of aquatic criteria have been made using the then current USEPA guidelines and for the protection of human health ranged from 6.3 to 44.15 micrograms/L and for the protection of aquatic life ranged from 60 to 900 micrograms/L for the maximum concentrations and 40 micrograms/L for a continuous concentration. Available data for calculating water quality criteria were insufficient to meet all the EPA guideline requirements. However, enough data were available to calculate a reasonable estimate of the criterion maximum concentration, 557 micrograms/L, to protect aquatic life. (Lantz-PTT)
W89-03348

METAL VALUE RECOVERY FROM METAL HYDROXIDE SLUDGES: REMOVAL OF IRON AND RECOVERY OF CHROMIUM,
Montana Coll. of Mineral Science and Technology, Butte. Dept. of Metallurgical and Mineral Processing Engineering.
For primary bibliographic entry see Field 5D.
W89-03361

ALTERNATE CONCENTRATION LIMIT GUIDANCE: BASED ON SECTION 264.94 (B) CRITERIA. PART II: CASE STUDIES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.

Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214267. Price codes: A22 in paper copy, A01 in microfiche. Report No. EOA/530-SW-87-031, May 1988. Interim Final Report. 598p, 67 fig, 58 tab, 82 ref, 14 append.

Descriptors: *Water pollution control, *Hazardous wastes, *Water quality control, *Alternate concentration limit, *Case studies, *Regulations, Legislation, Groundwater quality, Aquifers, Monitoring.

The hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA) require owners and operators of hazardous waste facilities to utilize design features and control measures that prevent the leaking of hazardous waste into groundwater. To establish the facility's groundwater protection standard (GWPS) under Subpart F (40 CFR 64.92), the Regional Administrator is required to establish in the facility permit, for each hazardous constituent entering the groundwater from a regulated unit, a concentration limit that cannot be exceeded. The concentration limits are the 'triggers' that determine when corrective action is required. There are three possible concentration limits that can be used to establish the GWPS: (1) Background levels of the hazardous constituents, (2) Maximum concentrations listed in the regulations, or (3) Alternate concentration limits (ACLs). To establish ACLs, two points must be defined on a RCRA facility's property: the Point of Compliance (POC) and the Point of Exposure (POE). The POC is the place in the uppermost aquifer where groundwater monitoring takes place and the groundwater protection standard is set. The ACL, if it is established in the permit, would be set at this point. The POE is the point at which it is assumed a potential receptor can come in contact, either now or in the future, with the contaminated groundwater. Therefore, the groundwater quality at the POE must be protective of that receptor. Five case studies present a series of examples of the type of information that would be appropriate for ACL demonstrations under 40 CFR Part 264.94(b). They are designed to serve as models to aid in implementing Part I of the ACL Guidance Document. As such, they represent the five types of ACL cases presented, but are hypothetical examples based in part on actual hazardous waste facilities. (Lantz-PTT)
W89-03369

INSTALLATION RESTORATION PROGRAM. PHASE II - CONFIRMATION/QUANTIFICATION STAGE 2.
Dames and Moore, Park Ridge, IL.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A192375. Price codes: A22 in paper copy, A01 in microfiche. 545p, 5 tab, 22 plates, 12 append. USAF Contract F33615-83-D-4002.

Descriptors: *Water pollution control, *Monitoring, *Cleanup, *Monitoring, *Fate of pollutants, *Path of pollutants, Soil samples, Wells, Groundwater quality, Hydrocarbons, Fuel, Pesticides, Aromatic compounds, Lead.

The Phase II, Stage 2 field evaluation of the Installation Restoration Program (IRP) was conducted at Elmendorf Air Force Base, Anchorage AK. It consisted of investigations at the following 12 sites: Site D-5, Sanitary Landfill; Sites SP-7 and SP-10, Pumphouse No. 3; Site D-7, Sanitary Landfill; Site SP-5, JP-4 Tank Spill; Site SP-12, JP-4 Fuel Line Leak; Site D-17, Shop Waste Disposal; Site SP-11, JP-4 Fuel Line Leak; Site FT-1, Fire Training Area; Site SP-2, JP-4 Fuel Line Leak; Site SP-14, MOGAS Spill; and Site IS-1, Building 42-400 Floor Drains. The field investigation consisted of the following activities: (1) Performance of magnetometer surveys at Sites D-5 and D-7 to determine the boundaries of the site; (2) Performance of soil gas surveys at Sites SP-7, SP-10, SP-5, SP-12, FT-1, SP-2, SP-11, and SP-14; (3) Drilling, soil sampling, and geologic logging of eleven borings; (4) Installation of monitor wells in the eleven new borings; and (5) Analysis of selected ground and surface water samples from the eleven new monitor wells, the existing nineteen monitor wells (installed during Phase II, Stage I), four base water supply wells, three locations along Ship Creek, and one location on Cherry Hill Ditch for petroleum hydrocarbons, purgeable halocarbons, purgeable aromatics, pesticides, lead, total dissolved solids, and major cations and anions. (Lantz-PTT)
W89-03372

INSTALLATION RESTORATION PROGRAM. PHASE II - CONFIRMATION/QUANTIFICATION. STAGE 2 - BULK FUEL STORAGE AREA FUEL SPILL INVESTIGATION.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5B.
W89-03376

RATES OF NUTRIENT UPTAKE AND GROWTH OF THE WATER HYACINTH (EICHHORNIA CRASSIPES (MART.) SOLMS),
Hiroshima Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 5D.
W89-03430

USE OF METAGAME ANALYSIS IN ACID RAIN CONFLICT RESOLUTION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03458

LOAD CONTROL REGULATION OF WATER POLLUTION: AN ANALYSIS USING GAME THEORY,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-03459

REDUCING IMPACTS OF NONPOINT SOURCE POLLUTION FROM AGRICULTURE: A REVIEW,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-03488

CLEAN WATER SUPPLY DEPENDS ON MANAGEMENT OF GROUNDWATER,
Greeley and Hansen, Chicago, IL.
M. Hsu, and T. J. Hodnik.
Consulting - Specifying Engineer, Vol. 3, No. 7, p 54-58, June 1988. 4 fig.

Descriptors: *Water quality management, *Radium radioisotopes, *Water softening, *Water treatment, *Drinking water, *Groundwater management, Groundwater pollution, Lime, Reverse osmosis, Ion exchange, Water pollution prevention.

The way that groundwater is managed today will greatly affect the availability of clean water in coming decades. All potable water supply facilities in the United States will be required to comply with the Safe Drinking Water Act Amendments of 1986. These amendments direct the EPA to develop maximum contaminant levels (MCLs) and monitoring programs for 83 contaminants by 1989. Radium is a radioactive element typically present nationwide in deep well groundwater. Radium levels can be lowered by blending deep and shallow well water. Technologies available for the removal of radium in groundwater include: lime or lime-soda precipitation, ion exchange, adsorption, and reverse osmosis. The lime or lime-soda processes of water softening also reduce water hardness. Ion exchange in sodium form achieves 90-97% radium removal. Calcium-based and hydrogen-based resins used in ion exchange have been found to simultaneously increase radium removal capacity and decrease sodium content in the finished water. Reverse osmosis techniques commonly used for desalinating sea water remove 85% to 98% radium. Radium removal is cost-effective when intentionally done with either hardness removal or water desalination. Waste management must be considered when selecting a radium removal procedure. The implementation of groundwater protection laws is important to the management of drinking water quality. In June 1987, the EPA published criteria for identifying critical aquifer protection areas that are considered vulnerable to contamination. The 1986 Safe Drinking Water Act Amendments require that, by June 1989, states develop contamination protection programs for areas around wells that supply public drinking water. In a rule effective September 1987, the EPA revised the list of chemicals to be monitored in groundwater adjacent to Resource Conservation and Recovery Act land-based facilities that treat, dispose of or store hazardous wastes. All of these changes will greatly affect the way water utilities manage groundwater quality. (Geiger-PTT)
W89-03492

BIRCH LEAF PROCESSING AND ASSOCIATED MACROINVERTEBRATES IN AN ACIDIFIED LAKE SUBJECTED TO LIMING,
Bergen Univ. (Norway). Zoological Museum.
A. Fjellheim, and G. G. Raddum.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 89-94, January 8, 1988. 4 fig, 1 tab, 26 ref.

Descriptors: *Acid rain effects, *Lake restoration, *Acidity, *Lime, *Macroinvertebrates, *Leaves, *Decomposing organic matter, Hydrogen ion concentration, Particulate matter, Benthic fauna, Midges, Food habits, Species composition, Norway, Detritus.

As part of the Norwegian 'Liming Project', Lake Store Hovvatnet, a chronically acid lake in southern Norway, was treated with lime. In the autumn of 1981, a half year after liming, a series of mesh bags containing leached and dried birch leaves was placed in a pH gradient in the limed lake and in a nearby unlimed lake. During the experiments, which lasted two years, no significant differences in decomposition rates between the various localities at the same depth were noticed. A collector organism, the chironomid Tanytarsus pallidicornis, was the dominant invertebrate species in the benthic samples. This demonstrates the importance of fine particulate organic matter as a food source in the lake. Collector dominance was lower in the leaf bags, which consisted mostly of coarse particulate organic matter. The effect of liming on the benthic invertebrate community of acidified lakes is dependent upon both the faunal composition prior to liming and immigration/extinction rates of species. A poor fauna of detritus grazers probably contributed to the unchanged rates of decomposition of the leaves after liming. (Shidler-PTT)
W89-03545

ZOOPLANKTON OF A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND): SEASONAL CHANGES AND THE INFLUENCE OF WATER QUALITY MANAGEMENT MEASURES,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-03546

FIELD OBSERVATIONS ON THE INFLUENCE OF LOW WATER VELOCITIES ON DRIFTING OF BULINUS GLOBOSUS,
Institut Tropical Suisse, Ifakara (Tanzania). Field Lab.
For primary bibliographic entry see Field 2H.
W89-03547

CHANGES IN THE ABUNDANCE OF BLUE-GREEN ALGAE RELATED TO NUTRIENT LOADINGS IN THE NEARSHORE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W89-03555

NITROGEN DYNAMICS IN A EUTROPHIC LAKE SEDIMENT,
Florida Univ., Gainesville. Inst. of Food and Agri-

cultural Sciences.
For primary bibliographic entry see Field 2H.
W89-03560

NITROGEN CYCLE IN SHALLOW WATER SEDIMENT SYSTEMS OF RICE FIELDS: PART III. THE INFLUENCE OF N-APPLICATION ON THE YIELD OF RICE,
Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman, C. Bonetto, and F. Minzoni.
Hydrobiologia HYDRB8, Vol. 159, No. 2, p 211-217, March 15, 1988. 4 tab, 10 ref.

Descriptors: *Ferilizers, *Soil-water-plant relationships, *Nitrogen cycle, *Sediments, *Rice, *Fertilization, *Crop yield, Deltas, Environmental protection, Eutrophication, Denitrification, Field tests, Culturing techniques, Farming, Crops, Conservation, Irrigation water, Nitrogen fixation, Mineralization, Crop yield, Carp, Water pollution prevention.

Fertilizer application to rice fields in river deltas in the Mediterranean area is a potential menace to wildlife protection, through eutrophication. A nitrogen-fertilizer-application rate of 200 kg N/ha has become normal and a rate of 400 kg/ha has been recorded. N is often applied long before the rice can take it up. Denitrification causes large losses of N, resulting in the application of more fertilizer. Therefore an attempt was made to develop application techniques requiring smaller, more efficiently used, amounts of N. In order to do this an N budget for rice fields was established. Experiments were set up in fields (550 square m) and in pots (2-3 l). This work has revealed some surprising effects with potentially-important consequences for farming practice and, therefore, for conservation. The N budget shows that 15 1.5 g/square m of N is needed for a normal crop. N losses due to denitrification may be as high as 12.2-13.6 g/square m of N. Irrigation water may provide up to about 20% of the input; N fixation is negligible. It is estimated that 25-50% of the N missing in the budget comes from mineralization of the organic-N pool in the soil; denitrification may render part of this pool bioavailable by oxidation. The results suggest that a late application of N (e.g., when the rice shows signs of N deficiency by becoming yellowish), at lower concentrations (70 kg/ha) can produce the same ultimate yield. The introduction of carp without any further input of N produced the same final yield. (See W89-03561 thru W89-03562) (Author's abstract)
W89-03563

USE OF PERIPHYTON COMMUNITIES FOR NUTRIENT REMOVAL FROM POLLUTED STREAMS,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
J. Vymazal.
Hydrobiologia HYDRB8, Vol. 166, No. 3, p 225-237, September 30, 1988. 4 fig, 6 tab, 44 ref.

Descriptors: *Water pollution treatment, *Water pollution control, *Nutrient removal, *Stream biota, *Plant populations, *Epiphytes, Ammonium, Nitrites, Nitrates, Orthophosphates, Organic compounds, Trophic level, Artificial watercourses, Species composition.

The results of experiments on the efficiency of nutrient removal conducted in a continuous flow-through trough are given. The artificial stream (5 m x 0.7 m x 0.5 m) was made of wood, with silon (a kind of nylon) screens as a substratum for periphyton growth. The elimination of nutrients was monitored by ammonium, nitrite, nitrate, and orthophosphate analyses. In addition, the elimination of organics and the decrease in trophic state were determined. During two field experiments a marked elimination of nitrogen and phosphorus was demonstrated. The maximum efficiency of ammonium and orthophosphate removal was 80% and 70%. Inorganic and organic nutrient elimination caused significant changes in periphyton community structure in the outflow portion of the trough, evaluated by the saprobic index and the similarity coefficient. The experiments confirmed that periphyton communities are a useful means of nutrient removal from polluted streams. (Author's abstract)
W89-03594

ACTIVATED CARBON ADSORPTION OF PCBS FROM HAZARDOUS LANDFILL LEACHATE,
University of Southern California, Los Angeles. Environmental Engineering Program.
M. Pirbazari, M. R. Stevens, and V. Ravindran.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 28, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 369-370. 2 ref.

Descriptors: *Water pollution treatment, *Toxic wastes, *Activated carbon, *Polychlorinated biphenyls, *Landfills, *Humic acids, *Leachates, Adsorbents, Organic compounds, Equilibrium.

The activated carbon adsorption of polychlorinated biphenyls from a hazardous landfill leachate was investigated. Equilibrium studies were performed using different leachate constituents. Additionally, equilibrium tests were conducted to assess adsorption of polychlorinated biphenyls on leachate sediments. Dynamic studies led to the suspicion that humic substances were a possible cause for premature breakthrough of polychlorinated biphenyls in carbon columns. It was concluded that complexation between humic acid and polychlorinated biphenyls generated complexes that impaired the adsorption of polychlorinated biphenyls. (See also W89-03595) (Author's abstract)
W89-03644

LAKE WATER QUALITY MANAGEMENT IN JAPAN,
Environment Agency, Tokyo (Japan). Water Quality Bureau.
M. Ozawa.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 29-50, 3 fig, 5 tab.

Descriptors: *Water pollution control, *Lake restoration, *Water quality, *Wastewater treatment, *Management planning, *Japan, Nitrogen, Phosphorus, Effluent, Lakes, Rivers, Reservoirs, Fishing.

Lakes and rivers in Japan have played an important role as resources for municipal water supply, recreation, fresh water fisheries, and other purposes. However, the country's high economic growth changed both the social and economic environment surrounding these water bodies, resulting in rapid deterioration of their quality starting in the late 1960's. The Water Pollution Control Law, enacted in 1970, established control measures to prevent contamination of public water. Fresh water red tide has appeared in Lake Biwa, the largest lake in Japan, considered to have the strongest resistance to eutrophication among all of Japan's lakes. In lakes which are more susceptible to eutrophication, such as Lake Kasumigaura, water bloom develops every year. In December 1982, the Environment Agency established the Environmental Water Quality Standards on nitrogen and phosphorus to control lake eutrophication. In July 1985, the Water Pollution Control Law specified uniform National Effluent Standards on nitrogen and phosphorus to control the abundant organic production of phytoplankton. The Clean Lakes Law introduced regulations to cope with those pollution sources for which the conventional effluent controls do not work. The five designated lakes are: Kasumigaura, Inbanuma, Teganuma, Biwa, and Kojima. Regulations control the pollutant load from new or expanded factories and other businesses; effluent controls on specified facilities, the structure and use of certain facilities and total pollutant loads. In addition to legal controls, prefectural governors can extend guidance, and make advice or recommendations concerning pollution sources. Standards for nitrogen are applied to a smaller number of lakes and reservoirs than the standards for phosphorus. (See also W89-03657) (Davis-PTT)
W89-03659

NATION'S WATER QUALITY: INTO THE 21ST CENTURY,
Environmental Protection Agency, Washington, DC. Municipal Facilities Div.
R. J. Blanco.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 365-390.1 fig.

Descriptors: *Water pollution control, *Water pollution treatment, *Legislation, *Water quality, *Water quality standards, Congress, Impacted rivers, Estuaries, Stormwater discharges, Toxics, Sludge, Budgeting.

The new Water Quality Act of 1987 made important corrections to existing pollution control legislation and was passed in order to build upon progress achieved since 1972 which include: the Construction Grants Program which has assisted in the completion of improvement projects at over 4600 sewage treatment plants; expenditures at the Federal, state and local level which have allowed an increase of population served by secondary treatment by more than 50 million people since 1972; state governments successfully assigning designated use and water quality criteria to the waterbodies of the United States; more than 60,000 point source dischargers were issued permits; substantial improvements in water quality management capability and expertise occurring at the State and local levels of government; and water quality improvements despite substantial population growth and industrial development. Although most waterbodies have maintained the same water quality since 1972, over 4 times more stream miles have been improved than have been degraded. The Water quality Act of 1987 will address such issues as: developing innovative methods for financing of municipal facility construction, controlling nonpoint source pollution, providing adequate environmental protection for estuaries, controlling municipal and industrial stormwater discharges, identification and control of toxic pollutants, and establishing programs, including regulation, for sewage sludge management. (See also W89-03657) (Davis-PTT)
W89-03670

SLUDGE MANAGEMENT AND ENERGY PRODUCTION AT LOS ANGELES COUNTY SANITATION DISTRICTS,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W89-03671

MICHIGAN'S PROCESS FOR REGULATING TOXIC SUBSTANCES IN SURFACE WATER PERMITS,
Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
P. D. Zugger, and J. E. Grant.
IN: Proceedings of the Eleventh United States/Japan Conference on Sewage Treatment Technology. Available from the National Technical Information Service, Springfield, VA as PB88-214986. Price codes: A99 in paper copy, E04 in microfiche. April 1988, p 475-602. 6 fig, 13 tab, 65 ref, 4 append.

Descriptors: *Water pollution control, *Surface water, *Hazardous materials, *Toxicity, *Michigan, *Legislation, Great lakes, Aquatic chronic value, Cancer risk, Mutagen values, Teratogen values.

A necessary aspect of a water pollution control program is a regulatory system that will not only provide nontoxic water quality conditions but also assure that toxic substances do not bioaccumulate in fish to levels unacceptable for human consump-

tion. In 1985, Michigan promulgated revisions to Rule 323.1057 of its Water Quality Standards that establish a regulatory process that will protect public health and the environment from discharges of toxic substances from point source surface water discharges. Rule 57(2) specifically addresses the development of allowable toxicant levels in the waters of the state applicable to wastewater discharges. The universe of chemicals to which the subrule applies is defined, an upper boundary on estimated excess risk of 1 in 100,000 for non-threshold carcinogens is established, comprehensive procedural guidelines are mandated, and a mechanism for issuance of scheduled abatement permits is provided. The application of Rule 57 has been very successful. When Rule 57 controls are fully implemented, Michigan will have essentially eliminated point source discharges as factors in toxic chemical pollution of Great Lakes water. Only after equivalent levels of control for atmospheric and nonpoint source loadings have been accomplished will the Great Lakes be protected. (See also W89-03657) (Davis-PTT)
W89-03674

USE OF BIOMONITORING IN MICHIGAN'S SURFACE WATER QUALITY PROGRAM,
Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
For primary bibliographic entry see Field 2H.
W89-03677

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT.
Proceedings of a Symposium held in London, U.K., 30 June-2 July 1987. Pergamon Press, New York. 1987. 435p. Edited by M.B. Beck.

Descriptors: *Water quality management, *Systems analysis, *Hydrologic cycle, *Operating policies, *Planning, *Acid rain, Conferences, Symposium, Water quality, Long-term planning, Management planning, Short-term planning, Water pollution, Water pollution control, Model studies, Mathematical models.

In the area of water quality management, systems analysis is concerned with all aspects of the water cycle and those facilities affecting and affected by the quality of that water. Its concerns range across the needs of planning and the needs of operations management. The symposium provided an opportunity to review both longer-term matters of planning and shorter-term considerations of the operational policies that will be necessary to satisfy and maintain these planned objectives. Ten papers make special reference to the topical issue of acid rain, and the proceedings conclude with a look forward to the potential of information technology. (See W89-03680 thru W89-03722) (Doria-PTT)
W89-03679

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT-A 25 YEAR RETROSPECT,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
R. V. Thomann.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 1-14, 7 fig, 19 ref.

Descriptors: *Systems analysis, *Water quality management, *Model studies, *Sediments, *Cost analysis, Reviews, Prediction, Performance evaluation, Legal aspects, Legislation, Optimization, Administrative decisions, Decision making, Oxygen, Dissolved oxygen, Eutrophication, Model testing.

A reflection is presented of the utility, credibility, and application of water quality systems analysis techniques over the past several decades. The emphasis is on predictive water quality models and the U.S. experience. The complexity of the water quality questions and associated modeling has increased by orders of magnitude. Models of sediment interactions and effects of toxic substances are crucial to further development. Four criteria for judging performance and impact are discussed: usefulness, accuracy, serendipity, and ownership. Models are widely used in decisions regarding alternative controls specifically to improve cost-effectiveness. The results of systems techniques need to be detailed in a wide ranging effort of post-audit analysis following implementation of environmental controls. Legislation and policies have incorporated, in a general way, the principles of water quality systems analysis, with the notable exceptions of a widespread reliance on technology based effluent programs and a general disregard of cost trade-offs using principles of optimization. It is concluded that the impact of systems techniques has been broad and significant. Increased quality assurance of model formulation and calculation is necessary to ensure frameworks that are rigorous and state of the art. A need exists for upgrading of understanding by users of water quality systems techniques, and the time has arrived for a major world-wide effort to compile the economic advantages of using systems techniques for more informed and efficient decision making. (See also W89-03679) (Author's abstract)
W89-03680

RELIABILITY BASED DISCRETE DIFFERENTIAL DYNAMIC PROGRAMMING MODEL FOR RIVER WATER QUALITY MANAGEMENT UNDER FINANCIAL CONSTRAINT,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
V. Joshi, and P. Modak.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 15-22, 1 tab, 12 ref.

Descriptors: *Systems analysis, *Water quality management, *Rivers, *Dynamic programming, *Economic aspects, *Optimization, *Developing countries, *Model studies, Basins, Catchment areas, River basins, Monte Carlo method, India, Algorithms.

The Dynamic Programming (DP) formulations for optimization in water quality management are reviewed. Existing methods for alleviating the problems of dimensionality are critically discussed along with their limitations. In this regard, a Discrete Differential Dynamic Programming (DDDP) formulation has been proposed. Since, in the case of developing countries, funds for improving basinwide water quality are rather scarce, this formulation is addressed to that of optimization under financial constraint. The model is extended to accommodate uncertainty in the system based on Monte Carlo simulation. For a specified level of reliability, the model maximizes the basinwide water quality for given financial resources. Computational experience shows that solutions obtained by existing DP formulations could be improved by DDDP. (See also W89-03679) (Author's abstract)
W89-03681

WATER QUANTITY AND QUALITY MODEL FOR THE EVALUATION OF WATER MANAGEMENT STRATEGIES IN THE NETHERLANDS-APPLICATION TO THE PROVINCE OF FRIESLAND,
Waterloopkundig Lab. te Delft (Netherlands). Water Resources and Environment Div.
For primary bibliographic entry see Field 6A.
W89-03682

IMPROVING THE EFFECTIVENESS OF ENVIRONMENTAL MANAGEMENT DECISIONS WITH OPTIMIZATION AND UNCERTAINTY ANALYSIS TECHNIQUES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 6A.
W89-03683

REDUCED RESIDENCE TIME EFFECT: IS THE LOWEST FLOW THE WORST FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 43-49, 2 fig, 1 tab, 7 ref.

Descriptors: *Systems analysis, *Water pollution control, *Residence time, *Water quality management, *Water quality standards, *Low flow, *Permits, Oxygen demand, Biological oxygen demand, Temperature, Standards, Flow, Legal aspects, Regulations, Water pollution, Effluents.

Under contemplated changes in water quality regulations, higher pollutant discharges may be allowed during times of higher streamflow (a dynamic permit rule). This may overlook the fact that, for multiple discharges of BOD and other decaying pollutants, conditions of higher flow may be worse because the reduced residence time between adjacent discharges may provide less opportunity for the river to recover from the effects of one discharge before being subjected to another. The significance of this effect depends on the values of the kinetic parameters and the flow, as well as the strengths of the discharges and the distances separating them. Examples are presented of rivers where the reduced residence time effect is important. These are followed by a discussion of implications for the design of waste abatement programs. It is observed, for example, that, for certain types of dynamic permits, very high flows should be chosen as the design flows for waste load allocation. Alternatives are proposed to the systems of dynamic permits currently under consideration by government agencies. (See also W89-03679) (Author's abstract)
W89-03684

DEVELOPING MANAGEMENT POSITIONS FOR ACIDIC EMISSION REDUCTION NEGOTIATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03685

REGIONAL APPLICATION OF A SIMPLE LAKE ACIDIFICATION MODEL TO NORTHERN EUROPE,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 6A.
W89-03687

SIMULATION AND ANALYSIS OF WATERSHED ACIDIFICATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 6A.
W89-03688

WATER QUALITY MODELING BY A LINEAR SYSTEM APPROACH,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03691

ANALYSIS OF HISTORICAL SURFACE WATER ACIDIFICATION IN SOUTHERN NORWAY USING A REGIONALIZED CONCEPTUAL MODEL (MAGIC),
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6A.
W89-03692

INTERACTION BETWEEN WATER QUALITY, ENVIRONMENTAL LEGISLATION, AND ECONOMICS IN A HYPOTHETICAL RIVER BASIN,
Environmental Protection Agency, Seattle, WA. Region X.
For primary bibliographic entry see Field 6A.
W89-03698

OPTIMIZATION MODELS IN WATER QUALITY CONTROL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).

For primary bibliographic entry see Field 6A.
W89-03699

SIMCAT-A CATCHMENT SIMULATION MODEL FOR PLANNING INVESTMENT FOR RIVER QUALITY,
Anglian Water Authority, Huntingdon (England).
For primary bibliographic entry see Field 6A.
W89-03700

DECISION SUPPORT SYSTEM FOR SELECTING EUTROPHICATION CONTROL STRATEGIES,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 6A.
W89-03701

DECISION SUPPORT SYSTEM FOR WATER MANAGEMENT IN REGIONS WITH INTENSE AGRICULTURE,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 6A.
W89-03702

OPTIMAL CONTROL OF SALTWATER INTRUSION: THE YUN LIN BASIN, TAIWAN,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 6A.
W89-03703

INCORPORATING PARAMETER UNCERTAINTY INTO GROUNDWATER QUALITY MANAGEMENT MODELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03704

INTERVENTION ANALYSIS TO ESTIMATE PHOSPHORUS LOADING SHIFTS,
Soap and Detergent Association, New York.
For primary bibliographic entry see Field 6A.
W89-03708

MODIFIED SET THEORETIC IDENTIFICATION OF AN ILL-DEFINED WATER QUALITY SYSTEM FROM POOR DATA,
Technische Univ. Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 6A.
W89-03709

UNCERTAINTY ANALYSIS IN WATER QUALITY MODELING USING QUAL2E,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03710

RECURSIVE RIVER WATER QUALITY ESTIMATION USING ABSTRACT EVOLUTION EQUATIONS IN FUNCTIONAL SOBOLEV SPACES,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6A.
W89-03711

OPERATIONAL WATER QUALITY MANAGEMENT: A SENSE OF PERSPECTIVE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck, B. A. Finney, and P. Lessard.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 357-368, 6 fig, 33 ref. NSF Grant INT-8420091.

Descriptors: *System analysis, *Water pollution control, *Water quality management, *Operating policies, *River basins, *Model studies, *Wastewater treatment, Basins, Catchment areas, Nitrification, Storm water, Wastewater, Wastewater facilities, Sedimentation, Sludge, Activated sludge, Lagoons, Wastewater lagoons, Rivers, Water quality, Nonpoint pollution sources, Oxygen demand, Biochemical oxygen demand, Oxygen, Dissolved oxygen, Nitrogen, Chlorophyll a, Case studies.

The management of water quality in highly developed, intensively used river basins has been moving slowly over the past decade towards a growing concern with shorter-term operational problems. This concern is most apparent in the increasingly widespread discussion of seasonal operating policies, particularly in respect to the nitrification of wastewater discharges, and in the attention now given to the effects of transient pollution events, such as stormwater overflows from sewers. The paper discusses the development and application of a set of models for simulating the dynamic behavior of a wastewater treatment plant and the associated receiving water body. Specific reference is made to the unit treatment processes of primary sedimentation, activated sludge, and post-treatment lagoons. The river water quality model quantifies the effects of both point-source and nonpoint-source discharges on the day-to-day in-stream interactions among the biochemical oxygen demand, dissolved oxygen, ammonium-N, nitrate-N, and chlorophyll-a concentrations. The development and application of the models is discussed with respect to experimental and case-study work at the Norwich and Milton Keynes Sewage Works and for the Bedford Ouse river system. (See also W89-03679) (Author's abstract)
W89-03716

AUTOMATIC WATER QUALITY MONITORING IN THE RIVER THAMES CATCHMENT-PRACTICAL ASPECTS OF SYSTEMS DESIGN AND UTILISATION,
Thames Water Authority, Reading (England).
For primary bibliographic entry see Field 7A.
W89-03717

QUAL2E - A CASE STUDY IN WATER QUALITY MODELING SOFTWARE,
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 6A.
W89-03718

WATER QUALITY MANAGEMENT IN THE AVE RIVER: FROM RESEARCH TO PRACTICE,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 6A.
W89-03719

NARRAGANSETT BAY: ISSUES, RESOURCES, STATUS AND MANAGEMENT.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 2L.
W89-03723

USE OF FLEXIBLE MEMBRANES IN PROTECTION OF GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
R. E. Landreth.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-195649. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/060, April 1988. 14p, 5 ref.

Descriptors: *Groundwater quality, *Water pollution control, *Membranes, *Leachates, *Landfills, *Water pollution prevention, Liners, Waste disposal.

Flexible membrane liners (FML) are increasingly being used to prevent leachate and other waste fluids generated at landfills, surface impoundments, and waste piles from entering the groundwater. The Hazardous and Solid Waste Amendments (HSWA) of 1984 requires liners and leachate collection components to be chemically resistant to the fluids to be contained, be constructed of materials that can be properly installed, maintained and repaired, and be durable. Landfill disposal facilities that are properly designed, constructed, and operated continue to provide an economical and safe method for disposing of hazardous waste. Landfills with two (or more) FML liners, a primary and secondary leachate collection and removal system that can withstand chemical attack, and an esthetically pleasing cover system with adequate vegetation, drainage, and barrier layer can meet governmental regulations. EPA has and continues to support research into specific areas of concern, e.g., the design and chemical resistance of a land disposal system's component parts and the establishment of guidelines for QA/QC plans relating to the construction of a land disposal facility. (Lantz-PTT)
W89-03730

CLOSING THE WATER SYSTEM ON PAPER MACHINES WITH A HIGH-RATE FLOTATION CLARIFIER,
Lenox Inst. for Research, Inc., MA.
M. Krofta, and D. B. Guss.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-168125. Price codes: A03 in paper copy, A01 in microfiche. Technical Paper No. LIR/09-85/175, May 20, 1986. 10p, 3 fig.

Descriptors: *Water reuse, *Water pollution prevention, *Pulp and paper industry, *Wastewater treatment, *Flotation, *Clarification, Costs, Economic aspects, Process water, Industrial water.

Some examples are given of application of a high rate flotation clarifier for closing the water system in paper making processes. The low cost and high efficiency of the high rate dissolved air flotation system have resulted in a large number of installations in the paper industry. Successful closure of the water system requires study of the process to apply the equipment with paths for reuse kept as simple and short as possible. The closed water system has been shown by experience to be technically achievable and also economically advantageous for papermaking processes. Environmental restrictions will increase and costs for water, sewer service, raw materials and energy will also increase. (Lantz-PTT)
W89-03734

DISSOLVED AIR FLOTATION PROCESSES,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W89-03735

OIL-SPILL RISK ANALYSIS: CENTRAL, WESTERN, AND EASTERN GULF OF MEXICO (PROPOSED SALES 113, 115, AND 116) OUTER CONTINENTAL SHELF,
Minerals Management Service, Reston, VA.
L. J. Hannon, R. P. LaBelle, and A. D. Lucas.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-166939. Price codes: A06 in paper copy, A01 in microfiche. OCS Report MMS 87-0117, October 1987. 123p, 5 fig, 15 tab, 13 ref, append.

Descriptors: *Management planning, *Risk analysis, *Oil spills, *Gulf of Mexico, Statistical analysis, Oil pollution, Prediction, Model studies.

The oil-spill risk associated with the Gulf of Mexico lease sales 113, 115, and 116 was analyzed. The three volume scenarios considered for the proposed action were Proposed, Low Find, and High Find. Also considered were the estimated volumes for Prior Sales, Future Sales, and Imports. Other volume scenarios were created from these six volumes. If the High Find volume scenario is considered, then 0.74 billion barrels of oil might be found and produced over a period of 22 years, compared to either the 6.21 billion barrels for the Prior Sales or the 72.00 billion barrels (over a period of 35 years) for Imports. The joint probabilities after 30 days for the Proposed Action are quite low. The highest value for the entire Gulf of

Mexico was a 27% chance of one or more spills occurring and contacting the Louisiana Marshes in the Central Planning Area (0.3 mean estimated number of spills). The Central Sea Turtle Nesting and Foraging Areas were the next highest (13% and 0.1). The Western Planning Area follows with a 12% chance (0.1) for the Texas Endangered Species. The Eastern Planning Area never exceeded 1% for any of the targets. The High Find Scenario somewhat increases the probabilities for each target. Compared to Prior Sales and Imports the estimated risk to resources of the Proposed Action is very small. Further, the risk from spills would be mitigated to the extent that weathering and decay of oil occurs at sea and by the success of any spill countermeasures that would be attempted. These effects were not directly included in this oil-spill model but should be considered in translating the spill contacts estimated by this study into spill impacts for environmental analysis. (Lantz-PTT)
W89-03737

ACCIDENTALLY SPILLED GAS-OIL IN A SHORELINE SEDIMENT ON SPITSBERGEN: NATURAL FATE AND ENHANCEMENTS OF BIODEGRADATION,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W89-03741

ENVIRONMENTAL PROJECTS: VOLUME 5. PART ONE: STUDY OF SUBSURFACE CONTAMINATION, PART TWO: GUIDE TO IMPLEMENT ENVIRONMENTAL COMPLIANCE PROGRAMS.
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 5B.
W89-03743

SALMON RIVER HABITAT ENHANCEMENT. ANNUAL REPORT: FY 1986, PART 1,
Shoshone-Bannock Tribal Fisheries Dept., Fort Hall Reservation, ID.
For primary bibliographic entry see Field 8I.
W89-03747

INSTALLATION RESTORATION PROGRAM. PHASE I - RECORDS SEARCH, AIR FORCE PLANT NO. 26, OHIO.
Engineering-Science, Inc., Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 020. Price codes: A06 in paper copy, A01 in microfiche. July 1985. 134p, 23 fig, 16 tab, 16 ref, 9 append.

Descriptors: *Pollutant identification, *Decontamination, *Ohio, *Water pollution treatment, *Cleanup operations, *Industrial wastes, Waste disposal, Hazardous wastes, Path of pollutants, Fate of pollutants, Waste management, Fuel.

Air Force Plant 36 is located in Evendale, Ohio, approximately 12 miles north of Cincinnati, and began during World War II as an aircraft engine production plant. Various portions of the plant facilities have served as aircraft engine test cells (Building B), storage (Building C-East), machine shop (Building D), and advanced engine research and test facilities (Buildings C-West and D). During the course of this project, interviews were conducted with installation personnel familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and federal agencies; and field surveys were conducted at suspected past hazardous waste activity sites. Two sites were initially identified as potentially containing hazardous contaminants and having the potential for contaminant migration resulting from past activities. These sites have been assessed using a Hazard Assessment Rating Methodology which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices. The area found to have sufficient potential to create environmental contamination is the underground fuel leak northwest of Building B, and the area judged to have a minor potential to create environmental contamination is the fuel spill at South Fuel Farm. The recommended remedial actions include: soil borings, monitoring wells and a sampling and analysis program to determine if contamination exists. This program may be expanded to define the extent and type of contamination if the initial step reveals contamination. (Lantz-PTT)
W89-03748

INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 6, GEORGIA.
CH2M Southeast, Inc., Gainesville, FL.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A190 945. Price codes: A10 in paper copy, A01 in microfiche. January 1984. 250p, 24 fig, 25 tab, 39 ref, 12 append. Air Force Contract F08637-80-G0010-5008.

Descriptors: *Path of pollutants, *Pollutant identification, *Water quality control, *Georgia, *Cleanup operations, *Water pollution prevention, *Monitoring, Industrial wastes, Groundwater pollution, Fate of pollutants, Oil pollution, Organic compounds, Solvents.

A private contractor was retained on August 17, 1983, to conduct an Air Force (AF) Plant 6 records search. The AF Plant 6 records search included a detailed review of pertinent installation records, contacts with 12 government organizations for documents relevant to the records search effort, and an onsite installation visit. The major industrial operations at AF Plant 6 include tooling, cutting, shaping, forming, cleaning, treating, and painting aircraft parts; subassembly of aircraft components; major assembly of aircraft sections; final assembly of entire aircraft; aircraft cleaning and painting; maintenance of building, aircraft, and aircraft-support equipment; and operations and support services. These industrial operations generate varying quantities of waste oils, recovered fuels, spent solvents and cleaners, plating sludge, paint sludges from water-wash paint booths, and heat-treatment salt wastes. In general, the standard procedures for past and present industrial waste disposal practices have been as follows: (1) waste oils and recovered fuels have generally been recycled or used to produce energy; (2) spent solvents and cleaners have been collected by contractors for offsite disposal; (3) concentrated plating baths have been treated prior to surface discharge; (4) dilute plating rinsewater wastes and oil wastewaters have been discharged to the sanitary Wastewater Treatment Plant or to the industrial waste treatment plant; and (5) plating sludges have been discharged to an earthen basin in the B-10 area or to the Surface Impoundment. Direct evidence (confirmed by laboratory analyses) of contaminant migration exists for several sites. A Phase II monitoring program is recommended to confirm or rule out the presence and/or migration of hazardous contaminants. In addition to the Phase II recommendations made for each disposal site, all existing and proposed monitoring wells should be surveyed to determine their groundwater surface elevations. (Lantz-PTT)
W89-03750

INSTALLATION RESTORATION PROGRAM. PHASE I - RECORDS SEARCH, MCCONNELL AFB, KANSAS.
Engineering-Science, Inc., Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A188 717. Price codes: A10 in paper copy, A01 in microfiche. August 1985. 223p, 24 fig, 14 tab, 24 ref, 11 append.

Descriptors: *Pollutant identification, *Waste disposal, *Kansas, *Cleanup operations, *Fate of pollutants, *Water pollution prevention, *Monitoring, Hazardous wastes, Path of pollutants, Industrial wastes, Waste management.

McConnell AFB is located in south central Kansas on the southeast side of Wichita, and became a permanent part of the Air Force in early 1952. During the course of this project, interviews were conducted with installation personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and federal agencies; and field surveys were conducted at suspected past hazardous waste activity sites. Twelve sites were initially identified as potentially containing hazardous contaminants and having the potential for contaminant migration resulting from past activities. These sites have been assessed using a Hazards Assessment Rating Methodology which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices. Eleven areas were found to have sufficient potential to create environmental contamination. Eleven other sites were reviewed and found not to have potential for contamination. A monitoring program with and other Installation Restoration Program activities at McConnell AFB is recommended. (Lantz-PTT)
W89-03751

ELEMENTS OF FLOATING-DEBRIS CONTROL SYSTEMS,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 4A.
W89-03769

FATE AND EFFECTS OF DISPERSED AND NON-DISPERSED OIL IN ARCTIC MUDFLATS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W89-03777

HAZARDOUS WASTE SITE MANAGEMENT: WATER QUALITY ISSUES. REPORT ON A COLLOQUIUM SPONSORED BY THE WATER SCIENCE AND TECHNOLOGY BOARD. COLLOQUIUM 3.
National Research Council, Washington, DC. Water Science and Technology Board.
For primary bibliographic entry see Field 5E.
W89-03783

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM,
Environmental Protection Agency, Washington, DC.
E. F. Barth, W. Hanson, and E. A. Shaw.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 22-33, 4 fig, 5 tab.

Descriptors: *Groundwater quality, *Regulations, *Water pollution prevention, *Standards, *Superfund, Water quality control, Water pollution treatment, Public health.

Decisions on contaminated groundwater at uncontrolled hazardous waste sites are complicated because of complex fate and transport patterns. The process being developed will guide remedial project managers and other decisionmakers concerned with groundwater remedial actions at Superfund sites so that a consistent groundwater evaluation and decision approach is applied to all such sites. In general, source control measures should facilitate the achievement of long term remediation objectives and goals for groundwater. The performance goal of each groundwater alternative should be expressed in terms of cleanup concentration and a time period for the restoration for all locations in the area of attainment. Performance goals in terms of groundwater concentrations may be available as maximum concentration levels (MCLs), proposed MCLs, or more stringent state standards. If these are not available, concentrations may be derived from health-based criteria such as excess unit carcinogenic risk (UCR) or referenced dose values. The decision as to which remedial

action alternative to select and implement depends on many factors. Those factors relating to the concentration level for carcinogens in the groundwater include other health risks borne by the affected populations and population sensitivities. Factors that influence the restoration time period for groundwater contaminated with carcinogens and noncarcinogens are as follows: feasibility of providing an alternative water supply; current use of groundwater; potential need for groundwater; effectiveness and reliability of institutional controls; and ability to monitor and control the movement of contaminants in groundwater. (See also W89-03783) (Lantz-PTT)
W89-03784

SOME APPROACHES TO SETTING CLEANUP GOALS AT HAZARDOUS WASTE SITES,
Clark Univ., Worcester, MA.
H. S. Brown.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 34-66, 2 fig, 4 tab, 9 ref.

Descriptors: *Cleanup operations, *Hazardous wastes, *Waste management, *Water pollution treatment, *Waste disposal, *Standards, Risk analysis, Fate of pollutants, Toxicity.

Hazard management at waste sites is more complex than at other locations because it involves multiple pathways of exposure. All of the methods reviewed (EPA, US Army, California, Washington State, New Jersey) in this paper focus on the protection of public health from the adverse effects of exposure to single toxicants as well as their mixtures, through single or multiple routes of exposure. The most favored approach to defining 'How clean is clean' for hazardous waste sites is that based on chemical-/media-specific numerical ambient acceptable concentrations for specific toxic materials. These criteria are derived separately for substances with and without carcinogenic properties. The similarities and differences among the five approaches are summarized and show that, despite the similarities in defining cleanup levels for hazardous waste sites, the differences in applying the general concepts are vast. The confusion in terminology, although frustrating, is the least of the problem. The most serious differences stem from variations in the basic assumptions about the environmental fate of chemicals, stringency of application of principles of toxicology, data base, use of existing standards/guidelines, use of safety factors, interconversion among routes of human exposure, acceptability of cancer risk, and extent of reliance on expert judgement. Because of this diversity, acceptable ambient concentrations derived by one method are not comparable with those from another. Finally, it is instructive to look at the results of this analysis in the context of the current emphasis on the separation of risk assessment from risk management. (See also W89-03783) (Lantz-PTT)
W89-03785

CALIFORNIA SITE MITIGATION DECISION TREE PROCESS: SOLVING THE 'HOW CLEAN SHOULD CLEAN BE' DILEMMA,
California Dept. of Health Services, Sacramento.
For primary bibliographic entry see Field 6A.
W89-03786

HOW CLEAN IS CLEAN. THE NEED FOR ACTION,
General Electric Co., Fairfield, CT.
T. M. Hellman, and D. A. Hawkins.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 98-109, 4 tab, 1 ref.

Descriptors: *Cleanup operations, *Management planning, *Regulations, *Costs, Economic aspects, Water pollution treatment, Waste management, Public policy, State jurisdiction, Federal jurisdiction.

The statutory definition of what factors must be considered in determining the acceptable level of cleanup varies from law to law. These definitions, which were developed by legislative processes in Washington, DC., and various state capitals, often are not clearly translatable to a determination of cleanup levels at remediation sites. Instead, they generate controversy and confusion. The practical result of this situation is that the cost of remediation increases as does the time required to implement solutions. Ultimately, fewer sites will be cleaned up. In this paper, the following issues are discussed: the current legal/regulatory framework relative to cleanup levels; the cost and technical implications of various cleanup strategies; the balance of today's cleanup costs versus future liabilities; and who ultimately pays. (See also W89-03783) (Lantz-PTT)
W89-03787

HOW CLEAN IS CLEAN. AN ENVIRONMENTALIST PERSPECTIVE,
Environmental Defense Fund, Washington, DC.
L. E. Greer.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 110-119.

Descriptors: *Management planning, *Cleanup operations, *Hazardous wastes, *Regulations, *Superfund, Legislation, Water pollution treatment.

The selection of cleanup levels for hazardous waste dump sites has been a priority issue within the environmental community since the original passage of the Superfund legislation. After lobbying the issue during the debate over the 1980 bill, the Environmental Defense Fund (EDF) oversaw the implementation of the statutory language and participated in the rule making that generated the National Contingency Plan (NCP), the set of regulations governing cleanups nationwide. EDF subsequently filed suit against EPA in 1982 over the agency's failure to resolve the cleanup standards issue in the NCP, arguing both that the agency's approach was not what was contemplated by Congress when it passed the law and that the approach was not adequate to protect human health and the environment from the toxic hazards posed by dump sites. Since 1982, the 'How clean is clean' question has expanded to include not only the question of the level of cleanup appropriate at dump sites but also the technology to be selected in undertaking a cleanup and the point of compliance at which the cleanup goals will be attained. These three issues have been addressed by environmental and citizens groups at particular sites as well as in lobbying efforts on the 1986 reauthorized Superfund bill. (See also W89-03783) (Lantz-PTT)
W89-03788

GROUND WATER CONTAMINATION ISSUES IN SANTA CLARA COUNTY, CALIFORNIA: A PERSPECTIVE,
Santa Clara Valley Water District, San Jose, CA.
R. R. Esau, and D. J. Chesterman.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 120-138, 1 fig, 7 tab.

Descriptors: *Groundwater pollution, *Santa Clara County, *Cleanup operations, *Public policy, California, Hazardous Wastes, Public participation, Water pollution treatment, Public education.

In the last few years, Santa Clara County, CA, has been the focus of state and federal attention in the area of hazardous materials regulation. The discovery of major groundwater contamination in 1981 set in motion a local regulatory response that has been the pattern for similar action throughout the state of California. Responsible agencies have also forged new ground with regard to remedial actions associated with existing incidents of contamination. Millions of dollars have been spent by private industry on cleanup activities while a cooperative relationship has been maintained between industry and government to the extent that expensive and time-consuming litigation has been avoided in almost all cases. The primary conclusion reached by responsible agencies in this area is that an informed public input must continue to be an integral part of decisions affecting the public health and environment. Public education and involvement mechanisms must be incorporated into the process, not only to allow public input on decisions affecting human health but also to enlighten the public with regard to the difficult trade-offs surrounding environmental decisions. This kind of process will enable mutually acceptable solutions to be reached with much greater ease. A final conclusion that becomes more evident as the technical realities of groundwater contamination become more widely understood, not only by the regulatory community but also by the public at large, is that there is necessarily some degree of risk that simply must be accepted. The reality is that even if sufficient funds were available, it would prove technically impossible to remove all of the contaminants from the ground. The obvious result is that some trace level of contamination in the water supply in some areas may, unfortunately, be inevitable. (See also W89-03783) (Lantz-PTT)
W89-03789

USING MODELS TO SOLVE GROUND WATER QUALITY PROBLEMS,
Florida Univ., Gainesville.
J. M. Davidson, and P. S. C. Rao.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 139-151, 17 ref.

Descriptors: *Mathematical models, *Groundwater pollution, *Path of pollutants, *Water quality control, Model studies, Monitoring, Groundwater quality, Biodegradation, Sorption, Water pollution prevention.

Mathematical models for describing the fate and transport of chemicals in porous media and numerical ranking schemes for assessing site vulnerability and contamination potential, appear to have a guarded role in policymaking, the development of environmental regulations, and the establishment of remedial actions for regulatory agencies responsible for groundwater. The models have not been satisfactorily validated to data and should not be used without some monitoring effort for the purpose of validation and/or calibration. The extent to which such efforts are conducted will depend on the purpose of the model as well as the areal extent to which the model is expected to be representative. The alternative to modeling is one of reaction through an extensive soil and groundwater monitoring program, a position that is not realistic if pristine groundwater conditions are the anticipated goal. The release of a chemical to the soil surface will eventually result in some portion of it reaching the groundwater, be it a large concentration or a very low concentration. Such attenuation results from degradation, sorption, and volatilization. Complete chemical containment or stabilization is the only waste disposal procedure currently available that provides groundwater protection; yet even these procedures are subject to engineering failures. (See also W89-03783) (Lantz-PTT)
W89-03790

MALARIA CONTROL BY ENGINEERING MEASURES: PRE-WORLD-WAR-II EXAMPLES FROM INDONESIA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
W. B. Snellen.
IN: International Institute for Land Reclamation and Improvement: Annual Report 1987. Wageningen, The Netherlands. 1988. p 8-21, 8 fig, 1 tab, 13 ref.

Descriptors: *Malaria, *Public health, *Human diseases, *Indonesia, *Environmental sanitation, *Drainage engineering, History, DDT, Mosquitoes, Rice, Irrigation, Ponds, Malaria.

This history of pre-World-War-II Indonesian malaria control begins with a history of the disease in ancient times and then describes basic malaria control strategies as used in the twentieth century. A brief overview of the use of DDT for mosquito control is presented. Topics discussed in relation to Indonesian experiences in malaria control include sanitations (malaria control by technical measures) in Sibolga, individual mosquito species sanitation, irrigated rice and malaria in the Cihea Plain, lagoons and malaria in Calang, mangrove forests and saltwater fishponds, and saline rice fields in Brengkok. It is concluded that irrigation and drainage engineers still have an important role to play in the control of malaria. (See also W89-03793) (Fish-PTT)
W89-03794

REGIONAL APPROACH FOR ASSESSING ATTAINABLE SURFACE WATER QUALITY: AN OHIO CASE STUDY,
Corvallis Environmental Research Lab., OR.
D. P. Larsen, D. R. Dudley, and R. M. Hughes.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 2, p 171-176, March-April 1988. 6 fig, 4 tab, 28 ref.

Descriptors: *Land use, *Water quality management, *Ohio, *Regional planning, *Streams, *Water pollution control, Watershed management, Spatial distribution, Project planning, Monitoring, Water pollution prevention, Case studies.

Land classification systems are useful for identifying areas of relative homogeneity among which attainable water quality varies according to predominant land type and present use. Five ecological regions in Ohio were delineated to evaluate a framework for assessing attainable water quality in small streams. Streams in relatively unimpacted, representative watersheds were selected in each region. Various water quality variables were sampled over a 16-month interval from July 1983 through November 1984. The highest water quality consistently occurred in the southeastern region; the lowest in the northwestern region. The correspondence between spatial patterns in water quality variables and the delineated regions, together with multivariate classification of the streams based on their major ion chemistry and nutrient richness, support the hypothesis that regional differences in attainable surface water quality occur and that a land classification system is useful for characterizing attainable water quality goals. Such a framework should be useful for planning, implementing, and monitoring pollution control programs. (Author's abstract)
W89-03893

CLAYEY BARRIER ASSESSMENT FOR IMPOUNDMENT OF DOMESTIC WASTE LEACHATE (SOUTHERN ONTARIO) INCLUDING CLAY-LEACHATE COMPATILIBILITY BY HYDRAULIC CONDUCTIVITY TESTING,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5E.
W89-03971

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: I. A CONCEPTUAL INTRODUCTION,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 7C.
W89-03984

DNA AMPLIFICATION TO ENHANCE DETECTION OF GENETICALLY ENGINEERED BACTERIA IN ENVIRONMENTAL SAMPLES,
Louisville Univ., KY. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W89-04002

CONTROL PLAN FOR SEATTLE METRO'S CSOS,
CWC-HDR, Inc., Edmonds, WA.
For primary bibliographic entry see Field 5D.
W89-04023

SUMMARY OF THE U.S. GEOLOGICAL SURVEY NATIONAL WATER QUALITY ASSESSMENT PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
R. M. Hirsh, W. M. Alley, and W. G. Wilber.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 88-95, 1988. 7p.

Descriptors: *Water quality, *Rivers, *Aquifers, Land use, Pesticides, Nutrients, Metals, Data collections, Monitoring.

Beginning in 1986, the Congress appropriated funds for the U.S. Geological Survey to test and refine concepts for a National Water Quality Assessment Program. At present, the program is in a pilot phase with field studies occurring in seven areas around the Nation. In 1990, a committee of the National Academy of Sciences will complete an evaluation of the design and potential utility of the program. A decision about moving to full-scale implementation will be made upon completion of this evaluation. The program is intended to address a wide range of national water quality issues that include chemical contamination, acidification, eutrophication, salinity, sedimentation, and sanitary quality. The goals of the program are to: (1) provide nationally consistent descriptions of current water quality conditions for a large part of the Nation's water resources; (2) define long-term trends (or lack of trends) in water quality; and (3) identify and describe the relations of both current conditions and trends in water quality to natural and human factors. This information will be provided to water managers, policy makers, and the public to provide an improved scientific basis for evaluating the effectiveness of water quality management programs and for predicting the likely effects of contemplated changes in land- and water-management practices. (USGS)
W89-04041

ENVIRONMENTAL PROTECTION IN HYDROTECHNICAL AMELIORATION WORKS,
For primary bibliographic entry see Field 6G.
W89-04218

BIOMEDICAL PROBLEMS OF HYDROTECHNICAL CONSTRUCTION,
For primary bibliographic entry see Field 6G.
W89-04222

ENGINEERING PROTECTION OF RESERVOIRS OF HYDROPOWER DEVELOPMENTS FROM FLOODING AND SUBIRRIGATION,
Y. S. Vasilev, and N. I. Khrisanov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 590-593, April 1988. 1 tab, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 21-23, October 1987.

Descriptors: *Water resources development, *Dam effects, *Environmental protection, *Flood prevention, *Embankments, *Reservoirs, *Soviet Union, Civil engineering, Hydroelectric power, Waterlogging, Cultivated lands, Construction costs, Regional planning.

Flooding and subirrigation (waterlogging) are the determining factors for ecological changes in areas influenced by hydrostation reservoirs. Insufficient attention is still being devoted to problems of protection from flooding and subirrigation when creating power and multipurpose reservoirs in the USSR. Only 200,000 hectares--about 6% of flooded agricultural (valuable flood-plain and long-cultivated) land--were embanked when constructing the Dnepr, Volga, Kaunas, Plyavinyas, Kairakkum, Krasnodar, and other hydro developments. The estimates of the construction costs of hydroelectric stations and reservoirs must include the cost, with appropriate substantiation, of embankment systems for preventing flooding or subirrigation and for conservation. All embankment-construction work should be done before the start of filling the reservoir; protection of lands at reservoirs already in operation costs several times more. Calculation methods (algorithms and computer programs) which verify optimal parameters for embankment systems and take into account their effects on the functioning of hydroelectric stations, other participants of the water-management complex, and the environment, have been developed for land protection and conservation and improvement of the ecological state of streams, reservoirs, and the below-dam areas of hydro developments. (Shidler-PTT)
W89-04223

ASSESSING STRATEGIES FOR CONTROL OF IRRIGATION-INDUCED SALINITY IN THE UPPER COLORADO RIVER BASIN,
R. L. Gardner, and R. A. Young.
American Journal of Agricultural Economics, Vol. 70, No. 1 p 37-49, February 1988. 4 tab, 28 ref.

Descriptors: *Irrigation effects, *Water pollution sources, *Water pollution prevention, *Saline water, *Agricultural runoff, *Colorado River Basin, Colorado, Utah, Wyoming, Irrigated lands, Taxes, Grand Valley model, Irrigation parameters, Alfalfa, Barley, Corn, Pasture, Pinto beans, Nonpoint pollution sources, Irrigation-return flow, Groundwater pollution, Aquifers, Subsidies, Effluent tax.

Dissolved mineral salts (salinity) adversely affect numerous urban and agricultural users of Colorado River water. More than a third of the salt load is thought to be induced by drainage from irrigated lands onto highly saline groundwater deposits. Taxes on water, water conservation subsidies, and land and water rights purchases were analyzed. The Grand Valley Model assumes that five crops (alfalfa hay, pasture, corn, edible dry beans, and barley) can be grown with any of ten combinations of water application technologies and management techniques: earthen ditch, earthen ditch with short sets, lined ditch, lined ditch with short sets, gated pipe, gated pipe with manual cutback, ported ditch, ported ditch with manual cutback, semiautomated ported ditch, and cablegation. An effluent tax on salt discharges is the most efficient approach. However, since the salt is embodied in nonpoint irrigation return flows, measurement problems would occur and monitoring the actual salt discharge from each field or estimating average salt discharges for various crops and irrigation techniques would be impractical. An alternative to taxing a nonpoint effluent is taxing an input to the process yielding the pollutant: the so-called influent tax. Reducing water use would reduce the deep percolation of water into the saline aquifers and thus reduce salt loading. An effluent tax on salt discharges would be the most efficient policy tool in terms of net social cost because the tax can be avoided only by lowering salt discharges. Influent taxes on irrigation water are less effective because of the imperfect correlation between water use and salt discharge. The lowest cost method to reduce salt loading the in Grand Valley is with improved irrigation practices. Economic efficiency has not been the most important goal in salinity management on the Colorado River. (Davis-PTT)
W89-04302

OBJECTIVES AND UNSOLVED PROBLEMS IN ECOTECHNOLOGY AND BIOMANIPULATION: A PREFACE,
J. Benndorf.
Limnologica LMNOA8, Vol. 19, No. 1, p 5-8, July 1988. 1 fig, 42 refs.

Descriptors: *Limnology, *Water quality control, *Water pollution prevention, Phosphorus, Chlorophyll a, Ecotechnology, Biomanipulation, Eutrophication, Lake Washington, Lakes, Reservoirs, Biocontrol, Lake restoration, Acidic water, Algae, Zooplankton.

The two different strategies to control water quality in fresh water are (1) the strategy of reducing the external load of nutrients, toxic substances, organic matter or acid precipitation and (2) the

strategy of controlling internal ecological processes (ecotechnology). The first strategy will provide acceptable solutions with respect to toxic substances, organic wastes, and acid precipitation. As far as eutrophication of lakes and reservoirs is concerned, a combination of both strategies leads to better water quality and, consequently, to a lower cost/benefit ratio in the management of the water resource compared with the application of the first strategy alone. One of the most impressive case studies showing the success of this cooperation of external load reduction and internal ecological mechanisms is Lake Washington. There are water bodies to which the first strategy cannot be applied for economic, political or technological reasons. In these cases, the second strategy offers a possibility to minimize the consequences of eutrophication or acidification and, therefore, it guarantees water use which otherwise would not be possible with the given external load. (Davis-PTT)
W89-04304

RELATIONSHIP BETWEEN ZOOPLANKTON BIOMASS AND GRAZING: A REVIEW,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. Lampert.
Limnologica LMNOA8, Vol. 19, No. 1, p 11-20, July 1988. 8 fig, 3 tab, 84 ref.

Descriptors: *Biomass, *Water pollution control, *Lake restoration, *Eutrophic lakes, *Zooplankton, *Biocontrol, Lake management, Phytoplankton, Algae, Seston, Lake Constance, Seasonal variation.

Zooplankton are a key factor for successful lake management by biomanipulation. A zooplankton-grazing relationship was established from field measurements to allow prediction of how much zooplankton is needed to significantly reduce the particulate matter in a particular lake. During periods when zooplankton build up biomass, clear-water phases occur. Periods when phytoplankton is reduced by zooplankton, resulting in very clear water, have been described for sewage ponds, low-stock fish ponds, and also for a number of meso- and eutrophic lakes. Provided that the sampling frequency is high enough, a period of extremely clear water following the spring bloom of small algae can be detected in many meso- and eutrophic lakes. Several seasonal records of phytoplankton biomass show clear spring depressions. A well-studied example is Lake Constance, where the Secchi transparency may increase from a little over 1 m to more than 10 m within a few days. This seasonal event is very predictable. Clearwater phases usually coincide with spring maxima of zooplankton. When zooplankton populations crash after the spring peak, algal biomasses usually recover, but the new biomass is often composed of different algal species. Grazing rates measured in situ may be as high as 200% a day in mesotrophic lakes but are much lower in eutrophic systems. High grazing rates, however, may not always mean high rates of particle elimination. Zooplankton can never eliminate all the particles in a lake since it filters only nannoseston. It is concluded that even in eutrophic lakes, phytoplankton can be controlled by grazing and that the zooplankton densities required to do this are not unreasonably high. (Davis-PTT)
W89-04305

CAN DAPHNIA PREVENT A BLUE-GREEN ALGAL BLOOM IN HYPERTROPHIC LAKES,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
P. Davidowicz, Z. M. Gliwicz, and R. D. Gulati.
Limnologica LMNOA8, Vol. 19, No. 1, p 21-26, July 1988. 7 fig, 27 ref.

Descriptors: *Lakes, *Daphnia, *Water pollution prevention, *Eutrophication, *Eutrophic lakes, Phytoplankton, Cyanophyta, Netherlands, Chlorophyll a, Loosdrecht Lakes.

The ability of large Daphnia to control the density of algal filaments was studied and the maximum concentration of filamentous blue-green algae at which Daphnia magna is able to survive and increase its population density was found. Water from hypertrophic Loosdrecht Lakes, dominated by blue-green algae, was passed through two sets of interconnected aquaria. Daphnia magna was introduced to one set, with the second set serving as a control. After a week of exposure the gut contents of Daphnia from the different aquaria were determined and compared with the composition of the seston in the aquaria. The density of filaments in the experimental set was significantly lower than in control, due to Daphnia grazing. Daphnia density was markedly reduced in the first aquarium of the set, in which a concentration of blue-green algae was very high, corresponding to 200 micrograms chlorophyll a/liter, but continuously increased up to the last aquarium, which had algal concentration only one-tenth of those in the first aquaria. Daphnia magna can control population growth of filamentous blue-green algae in nutrient-rich lake water. It can do so only if its population density is high enough to prevent blue-greens from reaching the concentration at which filtering rate and food ingestion of Daphnia are reduced below the threshold level necessary for the minimum reproduction required for maintaining its dense population. Daphnia caused a significant decrease in filament concentration and influenced the length distribution of filaments, by breaking up the longest trichomes. The effect of Daphnia on filaments was increased with decreased algal abundance. Increase in concentration of blue-green algae caused decrease in filtering rate and fecundity of Daphnia. The high concentration of filamentous blue-green algae should be considered as a strong factor influencing Daphnia demography. (Davis-PTT)
W89-04306

RESTORATION OF THE PELAGIC FOOD WEB IN ACIDIFIED AND LIMED LAKES BY GENTLE FERTILIZATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
H. Olofsson, P. Blomqvist, H. Olsson, and O. Broberg.
Limnologica LMNOA8, Vol. 19, No. 1, p 27-35, July 1988. 2 fig, 6 tab, 50 ref.

Descriptors: *Acid rain effects, *Lakes restoration, *Oligotrophic lakes, *Water pollution treatment, *Food chains, *Phosphorus, Limed lakes, Fertilization, Sweden, Phytoplankton, Lake Hecklan, Hydrogen ion concentration, Limiting nutrients, Zooplankton, Planktonic structure, Acidification.

Liming and subsequent fertilization was performed in a moderately acidified forest lake in central Sweden, to restore the autochthonous productivity. The fertilization experiment was carried out in Lake Hecklan an area that is dominated by coniferous forests and bogs. The lake has one visible inlet and outlet. During the first year of fertilization, total phosphorus levels in the epilimnion were doubled. The same level of total phosphorus was maintained in the epilimnion during the second year. Mean concentrations of total nitrogen were not elevated. The total nitrogen/total phosphorus ratio was well above 17, which indicates that phosphorus was the limiting nutrient for algal growth. The most pronounced effect of fertilization was found on biomass of phytoplankton, which was 10 times higher in the epilimnion in the second year of nutrient additions than during the reference year. The corresponding increase of biomass of zooplankton was around three times. In nonmanipulated lakes, total phosphorus decreases with decreasing pH. In acidified lakes with pH below 5, as well as in limed lakes, total phosphorus is usually lower. Natural oligotrophic lakes with a pH between 5 and 7 generally show algal species composition with few components considered as unfavorable food for herbivore zooplankton. These unfavorable algae constitute a much more important part of phytoplankton biomass in both acidified lakes and alkaline lakes with high nutrient contents. In lakes with a minimum of unfavorable algae there is a high efficiency in the planktonic food chain. The productivity of oligotrophic lakes susceptible to acidification must be governed by autochthonous processes, since the kind of lakes that easily become acidified are those in the upper parts of a river system having low water turnover. (Davis-PTT)
W89-04307

UNPLANNED BIOMANIPULATION IN LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson, and S. E. B. Abella.
Limnologica LMNOA8, Vol. 19, No. 1, p 73-79, July 1988. 4 fig, 2 tab, 38 ref.

Descriptors: *Eutrophic lakes, *Daphnia, *Biocontrol, *Water pollution treatment, *Lake restoration, Lake Washington, Washington, Longfin smelt, Cedar River, Transparency, Algae.

The concept of biomanipulation has been developed to include a group of techniques for the management or protection of lakes against eutrophication as an alternative to techniques that involve manipulating the chemical control system. Techniques of biomanipulation change the interactions among species in such a way as to improve the condition of the lake. Because Daphnia is able to increase the clarity of lakes by consuming small algae, it is an effective tool in biomanipulation of eutrophic lakes. Lake Washington became more transparent after an unexpected outbreak of Daphnia in 1976 than it had been before. The data suggest that Daphnia had previously been suppressed by two conditions: a relatively abundant population of the selective predator Neomysis and an abundance of the alga Oscillatoria which interferes with the feeding mechanism of Daphnia. Diversion of sewage effluent was responsible for the decrease in Oscillatoria. The reduction in Neomysis was correlated with an increased abundance of the longfin smelt, a fish that feeds selectively on Neomysis. The increase of smelt was probably facilitated by improvements in the physical conditions of the Cedar River that promoted spawning and survival. There is also a possibility that growth of the smelt population was aided by a decrease in the predatory Northern Squawfish. This experience suggests that desirable predators may be increased by manipulating the physical conditions that increase reproductive success. For a manipulation of physical conditions to be successful, the biological relationships of the species present must be considered. Techniques of biomanipulation can be broadened to include alteration of conditions in the watershed designed to improve the success of keystone species in the lake. (Davis-PTT)
W89-04308

TROPHIC INTERACTIONS IN THE HYPERTROPHIC LAKE TJEUKEMEER: TOP-DOWN AND BOTTOM-UP EFFECTS IN RELATION TO HYDROLOGY, PREDATION AND BIOTURBATION DURING THE PERIOD 1974--1985,
Limnologisch Inst., Oosterzee (Netherlands).
E. H. R. R. Lammens.
Limnologica LMNOA8, Vol. 19, No. 1, p 81-85, July 1988. 3 fig, 2 tab, 28 ref.

Descriptors: *Lake restoration, *Water pollution control, *Eutrophic lakes, *Daphnia, *Lake Tjeukemeer, Hydrology, Netherlands, Chlorophyll a, Fish, Zooplankton, Limnology, Hypertrophic lakes, Agricultural runoff, Temperature effects, Phosphorus, Eutrophication.

During the summer months of 1974-1985, chlorophyll-a and total phosphorus concentration, average size and density of Daphnia hyalina, biomass of smelt Osmerus eperlanus and bream Abramis brama and water temperature were monitored in Tjeukemeer, a shallow, hypertrophic and turbid freshwater lake in The Netherlands. A multivariate regression analysis showed a top-down effect between smelt and D. hyalina, in particular regarding the average size, and between bream and chlorophyll-a, and a bottom-up effect between total phosphorus and chlorophyll-a and between chlorophyll-a and D. hyalina. Significant negative correlations between chlorophyll-a on one side and water temperature and smelt on the other were probably related to the hydrology of the lake, which is largely determined by temperature and precipitation. During summer relatively nutrient poor IJsselmeer water enters the lake and dilutes

the nutrient rich water, which has entered the lake in winter from the surrounding fertilized agricultural areas. Both bottom-up and top-down effects are present in Tjeukemeer, but the bottom-up effects are more important than the top-down effects, due to the large impact of hydrology on the lake. Because of this dominating influence it is very difficult to reverse the eutrophication process by manipulating the food web. (Davis-PTT)
W89-04309

APPLICABILITY OF THE FOOD-WEB MANIPULATION IN THE RESTORATION PROGRAM OF A HYPERTROPHIC STRATIFIED LAKE: MODEL STUDIES FOR LAKE HAUSSEE (FELDBERG, GDR),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
P. Kasprzak, J. Benndorf, R. Koschel, and F. Recknagel.
Limnologica LMNOA8, Vol. 19, No. 1, p 87-95, July 1988. 6 fig, 2 tab, 68 ref.

Descriptors: *Eutrophic lakes, *Biocontrol, *Lake restoration, Lake Haussee, Hypertrophic lake, Food chains, Self-purification, Wastewater disposal, Zooplankton, Limnology.

Lake Haussee (Feldberg, GDR) is a highly eutrophic lake due to an external nutrient load from a municipal wastewater treatment plant. In 1980 the effluent was interrupted, but the lake remained in the state of hypertrophy because of the great amount of accumulated nutrients and high internal load. Investigations considering hydrology and chemistry and the structure of the food-web showed that the self-purification potential is rather low. The effect of food web manipulation was investigated by means of scenario studies using the ecological lake model SALMO. Decreased zooplankton mortality results in reduction of phytoplankton biomass. The second part of the spring maximum is nearly suppressed and the concentration throughout the rest of the year is 50 to 75 % lower. There are indications for interactions between food web manipulation and calcite precipitation, another important loss factor of phytoplankton in hard water lakes. Pelagic calcite precipitation with its connected decrease of primary production works most efficiently in mesotrophic lakes. Because food web manipulation leads also to limitation of phytoplankton growth, a stimulation of calcite precipitation can be assumed. (Author's abstract)
W89-04310

ENVIRONMENTAL ASSESSMENT OF PESTICIDES - A CONCEPTUAL APPROACH,
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-04353

QUANTIFYING RISKS OF TOXIC CHEMICALS TO AQUATIC POPULATIONS AND ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-04354

IMPERATIVES OF NONPOINT SOURCE POLLUTION POLICIES,
Harvard Univ., Cambridge, MA. Gordon McKay Lab.
P. Rogers, and A. Rosenthal.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 11, p 1912-1921, November 1988. 2 tab, 18 ref.

Descriptors: *Nonpoint pollution sources, *Water pollution sources, *Water pollution control, *Water policy, Water quality, Public policy, Regulations, Taxonomy, Path of pollutants, Runoff, Economic aspects, Legal aspects, Law enforcement, Surface water, Degradation, Pollutants.

The issues surrounding nonpoint source water pollution (NPS) are described. General guidelines for abatement policies require efficiency, equity, and effectiveness. The range of policy options, from voluntarism to command and control is presented. The technological and scientific imperatives for the study of NPS include taxonomy, measurement of pollutants, prediction of environmental phenomena such as rainfall, sites of pollutants, and types of interventions. Economic and financial issues are price response, benefit maximization, externalities, and financing requirements. Political and social issues include equity, irreversibility, statutes, and public acceptance. Institutional requirements such as agencies, local participation, and bureaucracy are also presented. These issues are discussed to stress the importance of regulating nonpoint source pollution which significantly contributes to the degradation of the nation's surface waters. (Stoehr-PTT)
W89-04366

UNCERTAINTY IN PH AND TEMPERATURE CORRECTIONS FOR AMMONIA TOXICITY,
Colorado Univ. at Boulder. Center for Limnology.
For primary bibliographic entry see Field 5B.
W89-04367

BIOLOGICAL IMPLICATIONS OF SEASONAL AND URBAN NITRATE (ACID) WET DEPOSITION,
Cincinnati Univ., OH.
For primary bibliographic entry see Field 5C.
W89-04404

PCB SEDIMENT DECONTAMINATION PROCESSES SELECTION FOR TEST AND EVALUATION,
Engineering Research Applications, Durham, NC.
B. H. Carpenter, and D. L. Wilson.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 3, p 185-202, Summer 1988. 5 tab, 27 ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Decontamination, *Water pollution treatment, Mathematical analysis, Sediment treatment processes.

Eight emerging alternative treatment processes for polychlorinated biphenyl (PCB) contaminated sediments were rated comparatively as to the desirability of their immediate thorough test and evaluation (T and E) based on their scores on 5 criteria: the probability of cleaning sediments to 2 ppm PCBs or less; the availability of a test system; the test effort required; the time required to provide a commercial size treatment system; and the probable cost of treatment using the process. Two rating methods were applied: a multiplicative model using a desirability function and a linear model, d-SSYS, using weighted utility functions. The three highest-rated processes were the following: the Basic Extraction Sludge Treatment (Resources Conservation Company); the UV/Ozone Treatment (Ozonic Technology, Inc.); and the Naturally-Adapted Microbes Process (Bio-Clean, Inc.). Four other processes ranked very close to the top three and merit consideration for testing at least through confirmatory phases: the Galson Potassium Polyethylene Glycolate Process; the New York University Low-Energy Extraction Process; the Critical Fluid MODAR Supercritical Water Oxidation Process; and the Critical Fluid Systems' Propane Extraction Process. (Author's abstract)
W89-04414

FIELD INVESTIGATION OF CLAY LINER PERFORMANCE,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 3, p 231-238, Summer 1988. 5 fig, 14 ref.

Descriptors: *Liners, *Water pollution prevention, *Landfills, *Clays, *Groundwater pollution, *Leachates, *Waste disposal, Infiltration, Clay cover liners, Clay, Moisture meters, Model studies.

Clay cover liners were investigated at hazardous and non-hazardous disposal facilities. Liners are typically constructed above waste landfills to impede the movement of moisture into the waste, thereby reducing the volume of moisture available for leachate generation. Water movement through a clay cover liner was monitored using an instrumented prototype lanfill and a numerical model of liner flows. The usefulness of soil moisture blocks was confirmed; thermo-couple psychrometers were less useful. Soil moisture changes in the liner occurred very slowly. The numerical model predicted much less leakage than that based on a water balance approach. The leakage through the lower liner was estimated based on moisture content fluctuations and was found to be less than predicted based on either the numerical model or water balance approach. This is probably due to the presence of macro-pores and the early post-construction period analyzed. (Brock-PTT)
W89-04416

WHAT ADVANTAGES CAN BE EXPECTED FROM THE ACCEPTANCE OF VARIABLE QUALITY STANDARDS FOR SEWAGE TREATMENT EFFLUENTS,
Lyonnaise des Eaux, Paris (France).
For primary bibliographic entry see Field 5D.
W89-04469

HYPOLIMNETIC AERATION RESEARCH IN BRITISH COLUMBIA,
British Columbia Ministry of Environment, Vancouver. Fisheries Research and Technical Services Section.
K. I. Ashley.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 215-219, January 1988. 1 fig, 13 ref.

Descriptors: *Hypolimnion, *Aeration, *British Columbia, *Water quality management, *Eutrophication, *Lakes, *Reservoirs, *Lake restoration, Fisheries, Eutrophic lakes, Aerators, Chemical properties, Physical properties, Biological properties, Turbidity, Oxygen, Ammonia, Phosphorus, Phytoplankton, Plankton, Aquatic plants, Destratification, Species composition.

Progress on a 10-year investigation of hypolimnetic aeration in British Columbia is reviewed. An experimental hypolimnetic aerator was installed in eutrophic Black Lake beginning in 1977. Aeration was found to have no effect on thermal stratification during the ice-free season, but circulated the entire experimental side under ice cover. Hypolimnetic oxygen concentrations were increased and oxygen consumption stimulated; there was a minimal effect on phytoplankton abundance and species composition. An engineering analysis of hypolimnetic aeration was then conducted; this involved an analysis of various compressor types, power sources, aerator designs, and performance characteristics. An empirical sizing method was developed for full lift aeration using hypolimnetic volume, hypolimnetic oxygen consumption, water flow, air flow, and inflow tube radius as the design criteria. Full-scale testing of the sizing procedure is now underway in two culturally eutrophic lakes. Further research is needed, particularly in the areas of nitrogen gas saturation, long-term effects on lake productivity, benthic recolonization, diffusor design, and cost-benefit analysis. (Doria-PTT)
W89-04500

EFFECTS OF RECLAMATION ON AN URBAN WINTER-KILL LAKE AT WINONA, MINNESOTA, U.S.A.,
Winona State Univ., MN. Dept. of Biology.
C. R. Fremling.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 341-345, January 1988. 1 fig, 9 ref.

Descriptors: *Limnology, Minnesota, *Lake restoration, *Eutrophication, *Water quality management, *Biocontrol, *Urban areas, *Aquatic weed

control, *Aeration, Trophic level, Lakes, Fishing, Fisheries, Lake fisheries, Oxygen, Dissolved oxygen, Transparency, Fish, Midges, Plankton, Zooplankton, Daphnia, Crustaceans, Aquatic plants, Aquatic weeds, Weeds.

Lake Winona, which lies within the city of Winona in southeastern Minnesota, is highly eutrophic because it receives nutrient-rich urban runoff and has stored erosion products from surrounding agricultural land. Severe winter kills in 1965 and 1969 allowed rough fish to dominate the lake until 1973, when it was reclaimed to create a sport fishery. Rehabilitation included: (1) aeration, (2) rotenone treatment, (3) installation of an electric weir at the lake outlet, and (4) restocking with bluegills, largemouth bass (Micropterus salmoides), smallmouth bass (Micropterus dolomieus), northern pike (Esox lucius), muskellunge (Esox masquinongy) walleye (Stizostedion vitreum) and channel catfish (Ictalurus punctatus). Fourteen species of fish were killed during the rotenone operation; Short-term impacts include increased transparency, increased levels of dissolved oxygen at all depths and seasons, increased numbers of benthic macroinvertebrates (predominantly chironomid larvae), rapid growth of fish (northern pike), and excellent fishing (especially for bluegills). Aeration was effective during fall, winter and spring, but was ineffective during summer stratification. Consequently, Lake Winona become virtually anaerobic at depths greater than 1.5 m from July through September. Curlyleaf pondweed (Potamogeton crispus) invaded the shallows causing severe nuisance problems. In 1981, it comprised an estimated 98% of the volume of weeds in the lake. Several experiments with an herbicide (Aquathol K) were unsuccessful, however, a weed cutter-harvester and onshore conveyer proved to be an effective, ecologically sound alternative. Ongoing management efforts also include biological control of fish populations by careful selection of predators. (Doria-PTT)
W89-04512

GREAT LAKES ECOSYSTEM EXPERIMENT,
Wisconsin Univ.-Madison. Sea Grant Inst.
For primary bibliographic entry see Field 2H.
W89-04514

DEVELOPMENT OF AN ENVIRONMENTAL SENSITIVITY INDEX FOR COASTAL AREAS OF LAKE ERIE, NORTH AMERICA,
Ohio State Univ., Columbus. Franz Theodore Stone Lab.
For primary bibliographic entry see Field 2H.
W89-04517

APPROACHES TO THE RESTORATION OF SHALLOW EUTROPHICATED LAKES IN ENGLAND,
University of East Anglia, Norwich (England). School of Environmental Sciences.
B. Moss, K. Irvine, and J. Stansfield.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 414-418, January 1988. 2 fig, 6 ref.

Descriptors: *Limnology, *Eutrophication, *Lake restoration, *Lakes, *Water quality management, Cost analysis, Nutrient removal, Phosphorus, Phytoplankton, Plankton, Aquatic plants, Daphnia, Crustaceans, Submerged plants, Trophic level, Isolation, Shallow water.

Strategies are outlined that are being used to restore the eutrophic Norfolk Broadland lake and river system (in England). These are shallow, lowland lakes with high phosphorus and nitrogen loading from a variety of sources, including release from lake sediments. The goal of restoration is to re-establish aquatic plants. The isolation of the lakes from effluent-rich rivers by dams and one-way sluices is unlikely to succeed without sediment removal where flushing rates are low. Once water has been improved to some extent by phosphate stripping, a switch from the phytoplankton state to the plant state might be achieved by husbandry of the large Cladocera, particularly Daphnia. This will require provision of suitable artificial refuges in which Cladocera populations can increase and move out to the open water to graze, clear it of phytoplankton, and allow submerged plants to establish. Several such refuges have been tested and their cost analyzed. Brushwood bundles of alder twigs bound together around a pole and pushed into the sediment proved effective and economical. It is concluded that the best solution for restoration, where isolation with sediment removal is not possible, is phosphate precipitation plus the provision of twig bundle Cladocera refuges. (Doria-PTT)
W89-04521

GONYOSTOMUM SEMEN-A NEW NUISANCE TO BATHERS IN NORWEGIAN LAKES,
National Inst. of Public Health, Oslo (Norway).
For primary bibliographic entry see Field 5C.
W89-04522

DOSE-EFFECT RELATIONSHIPS BETWEEN PHOSPHORUS CONCENTRATION AND PHYTOPLANKTON BIOMASS IN THE REEUWIJK LAKES (THE NETHERLANDS),
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2H.
W89-04528

ECOLOGICAL INVESTIGATIONS IN THREE SHALLOW LAKES OF DIFFERENT TROPHIC LEVEL IN THE NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands). Lab. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W89-04529

PHOSPHORUS METABOLISM AND EUTROPHICATION CONTROL OF LAKE BALATON,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
S. Herodek, V. Istvanovics, and J. Zlinszky.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 517-521, January 1988. 3 fig, 7 ref.

Descriptors: *Limnology, *Phosphorus, *Lake restoration, *Eutrophication, *Water quality control, *Lakes, *Lake Balaton, *Hungary, Metabolism, Trophic level, Orthophosphates, Mesotrophy, Phosphorus removal, Sediments, Wastewater, Water pollution sources, Chlorophyll A.

Phosphorus metabolism was studied in Lake Balaton, Hungary with a view to controlling eutrophication of the lake. The orthophosphate uptake of planktonic microorganisms follows Michaelis-Menten kinetics. The turnover time of the orthophosphate in the water is rather low: a few hours in winter and a few minutes in summer. The sums of the original substrate concentrations and of the half saturation constants are consequently higher in the hypertrophic than in the mesotrophic water, and they are lower than the soluble reactive phosphorus values. The ratio of the maximal phosphate uptake velocity to the primary production indicated more extreme P deficiency in the mesotrophic area than in the hypertrophic one. A project was begun in 1986 to stop eutrophication and to restore the water quality of 1960 by the year 2005. Two thirds of all the sewage waters produced in the surrounding recreational area are already diverted from the watershed of the lake, and P removal was introduced at several other sewage treatment plants. However, tributaries are the major source of P. Moreover, after the reduction of the external P loading, the recovery of the lakes can be appreciably delayed by the release of P accumulated in the sediments. The removal of the upper sediment layer in the hypertrophic basin is under consideration. (Doria-PTT)
W89-04530

RECOVERY OF AN INDUSTRIALLY ACIDIFIED, AMMONIUM AND HEAVY METALS POLLUTED LAKE (LAKE ORTA, N. ITALY), DUE TO THE ADOPTION OF TREATMENT PLANTS,
Istituto Italiano di Idrobiologia, Novara.
C. Bonacina, G. Bonomi, L. Barbanti, R. Mosello, and D. Ruggiu.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 535-544, January 1988. 3 fig, 3 tab, 29 ref.

Descriptors: *Limnology, *Italy, *Lake Orga, *Lake restoration, *Acidic water, *Lakes, *Ammonium, *Heavy metals, *Wastewater facilities, Industrial wastes, Water pollution effects, Copper, Chemical properties, Biological properties, Zooplankton, Plankton, Phytoplankton, Aquatic plants, Aquatic animals, Fauna, Benthic fauna, Benthos, Water currents, Lime.

Lake Orta is a glacial lake in Northern Italy that is heavily polluted by copper- and ammonium-containing effluent from a rayon factory, resulting in mortality of biota and acidification. The history of this pollution and its limnological consequences are described, along with the effects of treatment plans at the sites of major pollution sources and a plan for the liming of the lake waters. Liming is expected to produce the following effects in a short time: (1) neutralization of the lake and a reconstitution of its normal alkaline reserve; (2) precipitation of heavy metals with a consequent strong decrease in toxicity for lake biota and potential re-settlers; (3) enhancement of the nitrification of the residual ammonia; and (4) reconstitution of a much richer animal community, including zooplankton and fish. The construction of two treatment plants (and connected pipeline networks) that convey and treat most of the remaining industrial wastes and urban sewage complement the proposed liming within the framework of a general plan for the recovery of Lake Orta. On the basis of careful analyses of all relevant factors, it is concluded that the lake should be transformed into a 'quasi-normal,' P-limited, moderately productive water body. (Doria-PTT)
W89-04531

EUTROPHICATION OF LAKES AND RESERVOIRS IN ITALY,
Istituto di Ricerca sulle Acque, Brugherio (Italy).
G. F. Gaggino, and A. Provini.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 553-557, January 1988. 2 fig, 3 tab, 7 ref.

Descriptors: *Limnology, *Eutrophication, *Streams, *Reservoirs, *Italy, *Lake restoration, Trophic level, Reviews, Water quality, Water quality management, Phosphorus.

The Italian Water Research Institute is collecting data on lacustrine environments to determine their trophic conditions in order to establish realistic restoration objectives based on the receiving capacity of the lakes. Data on 150 lakes and reservoirs are available for the evaluation of water quality. The trophic status of Italian lakes is reviewed. Topics discussed include the distribution of N/P ratio, trophic classification, trophic status index, and phosphorus load. It is concluded that: (1) the external P load is lower than that acceptable for oligotrophic conditions in 14 lakes and is 3% to 5% higher in two subalpine lakes; (2) in 25 environments, the objective of oligotrophy can still be achieved by adequate intervention; and (3) in 28 lakes, only mesotrophic conditions can be reached by means of drastic P abatement programs. (Doria-PTT)
W89-04533

INFLUENCE OF RECREATION, MAINLY POWER BOATING, ON THE ECOLOGY OF THE THIRLMERE LAKES, N.S.W., AUSTRALIA,
Macquarie Univ., North Ryde (Australia). School of Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-04536

ESTIMATING NONPOINT SOURCES OF PHOSPHORUS TO LAKES,
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
For primary bibliographic entry see Field 5B.
W89-04537

PHOSPHORUS REDUCTION REQUIRED TO CONTROL EUTROPHICATION AT LAKE ROTORUA, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
E. White, G. Payne, S. Pickmere, and P. Woods.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 607-610, January 1988. 1 fig, 1 tab, 9 ref.

Descriptors: *Lake Rotorua, *Limiting nutrients, *Water pollution control *Limnology, *Phosphorus removal, *Eutrophication, *Lakes, *Lake restoration, Phosphorus, New Zealand, Trophic level, Water quality management, Chlorophyll A, Algae, Nitrogen, Nitrates, Nutrients.

Changes in the phosphorus concentration in eutrophic Lake Rotorua (New Zealand) required to reduce the average chlorophyll to 10 mg/cu m were assessed. It is concluded that to achieve this concentration, it would be necessary to reduce the P associated with chlorophyll a by 76%. A monitoring program by the Bay of Plenty Catchment Commission has demonstrated increasing concentrations of total phosphorus over recent years, averaging 73 mg/cu m by 1984-85, being associated with a chlorophyll a average of 17.2 mg/cu m. Application of these figures to the procedures developed here suggest that a 75% reduction of in-lake total phosphorus would be required to achieve a 42% reduction in chlorophyll a to an average concentration of 10 mg/cu m. (Doria-PTT)
W89-04540

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM WORK PLAN FOR FISCAL YEAR 1988.
Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-005292. Price codes: A10 in paper copy, A01 in microfiche. Report No. DOE/BP--905, October 1987. 207p, 1 fig, 10 tab.

Descriptors: *Bonneville Power Administration, *Wildlife, *Management planning, *Fish, *Columbia River Basin, Fisheries.

The FY 1988 Columbia River Basin Fish and Wildlife Program Work Plan (Work Plan) presents Bonneville Power Administration's (BPA) plans for implementing the Columbia River Basin Fish and Wildlife Program (Program) in FY 1988. The Work Plan focuses on individual Action Items found in the amended Program for which BPA has determined it has authority and responsibility to implement. Each of the entries in the Work Plan includes BPA's implementation objectives, background and progress to date in achieving those objectives, and a summary of plans for implementation in FY 1988. Most Action Items are implemented through one or more BPA-funded projects. A list of all past, present, and planned projects: along with objectives, results, schedules, and milestones for each project, follows each Action Item entry. The FY 1988 Work Plan emphasizes continuation of 95 ongoing projects, most of which involve protection, mitigation, or enhancement of anadromous fishery resources. These continuing activities are summarized briefly by Program area: Mainstem Passage, Artificial Propagation, Natural Propagation, Resident Fish and Wildlife, and Planning Activities. A major feature of the FY 1988 Work Plan is the provision of decision-making flexibility necessary to accomodate priority projects anticipated from new planning activities added during the recent amendment of the Program. (Lantz-PTT)
W89-03335

GENESEE RIVER BASIN STUDY. VOLUME 1: MAIN REPORT.
Corps of Engineers, Buffalo, NY. Buffalo District.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A190138. Price codes: A04 in paper copy, A01 in microfiche. August 1986. 90p, 7 fig, 12 tab, 5 plates.

Descriptors: *Genesee River, *New York, *Water resources development, *Water resources management, Management planning, Flood control, Hydroelectric power, Water supply, Water use, Water quality.

The Genesee River Basin Study Coordinating Committee identified the need for multi-purpose water resources development to include flood control, hydroelectric power, recreation, water quality, increased irrigation water, and refinement of municipal and industrial water supply. This report presents a systematized approach to the functional and developmental requirements of the Basin, and formulates alternative multi-purpose plans. It further identifies the problems, potential solutions to these problems, and recommends whether detailed feasibility studies are warranted. The study findings, analyses, and results are preliminary in nature, but conform with the study purpose and authority. Based on these results, the following conclusions were reached: (1) In terms of existing and projected supply and demand, the basin has important needs in the areas of flood control, municipal and industrial water supply, and general outdoor and fish and wildlife recreation. Other important needs are supplemental irrigation, protection from streambank and agricultural land erosion, and hydroelectric power generation; (2) As possible solutions to the basin water resource needs, 12 preliminary plans were formulated and assessed; (3) Hydropower development opportunities are realistic in view of the interests expressed by non-Federal entities in economically viable hydroelectric power projects; (4) The Canaseraga Creek Valley has adequate protection from the more frequent or highly probable floods. This protection is provided by levees and other flood measures built by local farmers with Governmental assistance. However, residual damages along the valley are significantly meaningful to justify some form of additional protection; and (5) The authorized flood control projects for Spring Creek in Caledonia, New York, and Red Creek in Monroe County, New York, should be deauthorized. These projects are no longer economically viable because of increased costs, changed conditions, and/or lack of local support. (See also W89-03371) (Lantz-PTT)
W89-03370

GENESEE RIVER BASIN STUDY. VOLUME 2: SUPPORTING DOCUMENTATION.
Corps of Engineers, Buffalo, NY. Buffalo District.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A190139. Price codes: A10 in paper copy, A01 in microfiche. August 1986. 231p, 5 append.

Descriptors: *Genesee River, *Water resources development, *Water resources management, *New York, Management planning, Flood control, Hydroelectric power, Water supply, Water use, Water quality.

The Genesee River Basin Study Coordinating Committee created in 1962, identified the need for multi-purpose water resources development to include flood control, hydroelectric power, recreation, water quality, increased irrigation water, and refinement of municipal and industrial water supply. This report presents a systematized approach to the functional and developmental requirements of the Basin, and formulates alternative multi-purpose plans. It further identifies the problems, potential solutions to these problems, and recommends whether detailed feasibility studies are warranted. These appendices to Volume 1 present data on, and discuss: hydrology and hydraulics, economics, cost estimates, environmental assessment, and public involvement. (See also W89-03371) (Lantz-PTT)
W89-03371

USE OF METAGAME ANALYSIS IN ACID RAIN CONFLICT RESOLUTION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03458

LOAD CONTROL REGULATION OF WATER POLLUTION: AN ANALYSIS USING GAME THEORY,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-03459

GRAPH MODEL APPROACH TO ENVIRONMENTAL CONFLICT RESOLUTION,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
L. Fang, and K. W. Hipel.
Journal of Environmental Management JEVMAW, Vol. 27, No. 2, p 195-212, September 1988. 3 fig, 10 tab, 24 ref.

Descriptors: *Environmental policy, *Models, *Decision making, *Management planning, *Graphical methods, International agreements, Irrigation programs, Project planning, Graphical analysis, Social aspects, Political aspects, Stability analysis, Prediction, Canada.

The recently developed graph form of the conflict model is used to analyze the Garrison Diversion Unit (GDU) conflict, a complex international environmental dispute between the United States and Canada involving a proposed irrigation project. This comprehensive conflict analysis methodology can accurately model a strategic situation, forecast compromise solutions, and social viability of a project. The analysis of the GDU dispute at two different points in time clearly demonstrates how the decisions of important governing agencies have determined the nature of the GDU project through their strategic effects on other participants; this analysis also indicates when and how compromises could be achieved. (Author's abstract)
W89-03460

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT.
For primary bibliographic entry see Field 5G.
W89-03679

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT-A 25 YEAR RETROSPECT,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5G.
W89-03680

RELIABILITY BASED DISCRETE DIFFERENTIAL DYNAMIC PROGRAMMING MODEL FOR RIVER WATER QUALITY MANAGEMENT UNDER FINANCIAL CONSTRAINT,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W89-03681

WATER QUANTITY AND QUALITY MODEL FOR THE EVALUATION OF WATER MANAGEMENT STRATEGIES IN THE NETHERLANDS-APPLICATION TO THE PROVINCE OF FRIESLAND,
Waterloopkundig Lab. te Delft (Netherlands). Water Resources and Environment Div.
J. J. Brinkman, P. S. Griffioen, S. Groot, and F. J.

Los.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 23-30, 6 fig, 1 tab, 10 ref.

Descriptors: *Systems analysis, *Model studies, *Water management, *Water supply, *The Netherlands, *Eutrophication, Resources management, Model studies, Rivers, Canals, Lakes, Ditches, Optimization, Computer models, Phytoplankton, Growth, Aquatic plants, Plankton, Model testing, Water distribution, Nutrients, Mathematical models, Friesland, Water quality.

The Netherlands has a rather complex water management system consisting of a number of major rivers, canals, lakes, and ditches. Water quantity management on a regional scale is necessary for an effective water quality policy. To support water management, computer models can play an important role to optimize the management strategies for such complex water systems. As most water quality problems are directly related to water movement, a computer model was developed that includes both water quality and water quantity. The model is based on three submodels: ABOPOL for the water movement, DELWAQ for the calculation of water quality variables, and BLOOM-II for the phytoplankton growth. The province of Friesland in the northern part of the country was chosen as a test case for the integrated model to be developed. The water quality in Friesland is highly related to the water distribution, and the main trade-off for the water manager is minimizing the intake of (eutrophicated) alien water in order to minimize external nutrient load, and maximizing the intake in order to flush channels and lakes. The results of the application of these models to the existing situation and to a number of hypothetical future situations are described. (See also W89-03679) (Author's abstract)
W89-03682

IMPROVING THE EFFECTIVENESS OF ENVIRONMENTAL MANAGEMENT DECISIONS WITH OPTIMIZATION AND UNCERTAINTY ANALYSIS TECHNIQUES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. D. Fontaine, and B. M. Lesht.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 31-41, 5 fig, 6 tab, 10 ref.

Descriptors: *Systems analysis, *Water quality management, *Optimization, *Environmental policy, *Uncertainty analysis, *Linear programming, *Model studies, Administrative decisions, Algorithms, Cost analysis, Great Lakes, Phosphorus, Nutrients, Decision making, Eutrophication.

The stochastic nature of environmental processes and forcing functions diminishes the credibility of management decisions based on models employing 'average' conditions. It is suggested that the environmental decision-making process must quantitatively account for environmental uncertainties. In doing so, management strategies can be formulated that are based on acceptable levels of risk to the environment. This uncertainty analysis approach is extended to include a linear programming optimization algorithm to demonstrate that acceptable risk scenarios can be devised that are cost-effective as well. This is demonstrated for the Great Lakes by showing that present and proposed phosphorus management plans have neither the probability of success nor the cost-effectiveness of a management plan based on a combined uncertainty-optimization analysis. Present and proposed phosphorus management plans are predicted to have at most a 55% overall probability of meeting Great Lakes phosphorus goals. The combined uncertainty-optimization approach points to management options whose overall probability of success in meeting Great Lakes phosphorus goals varies between 55% and 99%. The costs associated with these options also vary, but savings as great as $400 million per year could be realized with no diminution in goal achievement when compared to present and proposed management plans. (See also W89-03679) (Author's abstract)
W89-03683

DEVELOPING MANAGEMENT POSITIONS FOR ACIDIC EMISSION REDUCTION NEGOTIATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 51-59, 1 fig, 10 tab, 6 ref.

Descriptors: *Systems analysis, *Acid rain, *Model studies, *Linear programming, *Water quality management, *Negotiations, *Cost analysis, *Canada, Rainfall, Political constraints, Economic aspects, Costs, Tax rates, Effluent charges, North America.

A systems analysis model to examine alternative strategies for acid rain abatement has been developed and is being utilized to explore alternative scenarios. As an illustration of the potential environmental and economic implications to achieve various environmental objectives in Canada, a series of model applications were performed. (1) 50% Cut in Emissions: Each emission source was required to remove 50% pf its emissions. The costs ranged from $7.6/capita to $44.5/capita for emission control costs, for the different provinces. (2) Maximum Technological Removal: The annualized cost varied from $7.8/capita to $86.2/capita. This is the lowest deposition rate that Canada can obtain, acting without the cooperation of the U.S. (and without controls being implemented on the area sources). (3) Least cost 50% Reduction of Canadian Sources Exceeding 19,000 tonnes: The disparity in control costs ($/person) is substantially reduced in comparison with the previous alternatives. However, the sum of the emissions reductions in this alternative is much lower than the previous alternatives and yet the location and magnitude of the maximum deposition rate is unchanged from the second alternative. Two provinces have no required abatement in this alternative. Cost sharing provides a similar deposition level for a lower expenditure and an improvement in deposition levels in the U.S. and receptor locations in the province of Quebec. The cost-effectiveness of this co-operative approach has been demonstrated, but the cost-sharing problems remain. The transfer payment requirements/tax incentives make the determination of this approach rather complicated. However, if the deposition targets are set very stringently, most sources will be required to enact abatement and the problems of obtaining equity will be greatly diminished. The cost-savings form a cost-effective strategy, as opposed to an across-the-board cutback, are demonstrated as being substantial. However, the administrative problems associated with a cost-effective strategy are substantial. With the cost of effective strategy it is necessary to use tax write-offs and/or transfer payments to obtain equity between various sources.
W89-03685

REGIONAL APPLICATION OF A SIMPLE LAKE ACIDIFICATION MODEL TO NORTHERN EUROPE,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kamari, and M. Posch.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 73-84, 4 fig, 1 tab, 21 ref.

Descriptors: *Systems analysis, *Acid rain, *Lakes, *Model studies, *Europe, *Water quality management, *Decision making, Rainfall, Monte Carlo method, Dynamics, Administrative decisions, Environmental protection, Simulation.

The principal objective of the Regional Acidification Information and Simulation (RAINS) model is to assist in the evaluation of policies for controlling the acidification of Europe's environment. As part of this task, a dynamic model has been developed for describing the key processes assumed to be important in determining the long-term dynamics of surface water acidification. The input data available on a large regional scale are few. The model is regionalized by selecting input combinations from feasible ranges or frequency distributions. Monte Carlo techniques are used to determine those combinations of parameters that produce the observed present-day lake acidity distribution for each individual region, when the model is driven by a specified historical deposition. The ensembles obtained in this filtering procedure for each lake region are then used for the scenario analysis. The model runs, assuming different future energy-emission scenarios, suggest that all reductions in emissions are likely to reduce also the number of lakes being threatened by acidic deposition. In conclusion, the Monte Carlo method seems to provide a working tool for the application of catchment models on a large regional scale. (See also W89-03679) (Author's abstract)
W89-03687

SIMULATION AND ANALYSIS OF WATERSHED ACIDIFICATION,
National Water Research Inst., Burlington (Ontario).
D. C. L. Lam, A. S. Fraser, and A. G. Bobba.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 85-96, 8 fig, 1 tab, 21 ref.

Descriptors: *Systems analysis, *Expert systems, *Simulation, *Model studies, *Acid rain, Watersheds, Acidification, Rainfall, Monitoring, Catchment areas.

Simulation and analysis of watershed acidification can be conducted on the regional scale as well as the watershed scale. In the regional approach, the watersheds are treated as basic geographical units. A new expert system is proposed to link the monitoring data bases of the air, water, and soil regimes for testing simple regional models. In the watershed approach, the catchments become the basic units so that detailed subbasin processes are simulated and indepth experimental data are required. The linkage of simple and complex models, as well as the linkage of the monitoring and the process research data bases, is considered as part of the knowledge base in the expert system. Future development on model selection and scenario predictions with strong reference to this knowledge base is also discussed. (See also W89-03679) (Author's abstract)
W89-03688

PROBABILISTIC MODELS FOR COMBINED SEWER SYSTEM REHABILITATION ANALYSIS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-03689

SYSTEM APPROACH TO ANALYSIS OF WATER QUALITY DUE TO TRANSPORT MECHANISMS IN THE WATER ENVIRONMENT,
Maryland Dept. of Natural Resources, Annapolis.
B. B. Hsieh.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 109-118, 11 fig, 1 tab, 10 ref.

Descriptors: *Water pollution control, *Path of pollutants, *Systems analysis, *Water quality management, *Mixing, *Salinity, *Water temperature, *Model studies, Tides, Flow, River flow, Wind, Chesapeake Bay, Chemical properties, Physical properties, Temperature, Bays, Rheology, Stress.

Natural forcing factors such as tidal variations, riverflow, and wind stress are the major mechanisms for generating mixing or transport phenomena in the movement of water bodies. The effect of these mechanisms was studied on the two most significant transportable water quality parameters, salinity and water temperature, in the Upper Chesapeake Bay, a complex and dynamic water environment. The method is based on a multiple input and multiple output linear system. Two dif-

ferent kinds of multiple transfer function modelling techniques are used to simulate the output function. The modelling results indicate that the subtidal signal from the two bays dominates the fluctuation of non-seasonal water temperature. The high volume river discharge from the Susquehanna River is the most important factor influencing the salinity regime, although it contributes only lower frequency variability. The cross-bay component of remote wind shares the importance of riverflow for salinity in contrast to the longitudinal component of remote wind influences on the non-seasonal water temperature. The cross-bay (Delaware) component of local wind stress affects transport behavior the least. Details of the simulation, sensitivity analyses for each input variable, and control strategies which produce required regulating riverflow for a desired salinity scheme are presented. (See also W89-03679) (Author's abstract)
W89-03690

WATER QUALITY MODELING BY A LINEAR SYSTEM APPROACH,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
C. C. K. Liu.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 119-125, 5 fig, 7 ref.

Descriptors: *Path of pollutants, *Systems analysis, *Linear programming, *Water quality management, *Model studies, *Solute transport, Mathematical models, Mixing, Advection, Simulation, Model testing, Water pollution control.

Mathematical models are widely used to analyze the mixing and transport of contaminants in various types of receiving water bodies. However, the successful application of traditional physically-based models such as the advection-dispersion model is often limited because of difficulties in identifying model parameters and in incorporating random elements into the model. An alternative modeling approach can be established based on linear system theory. In this study, the compatibility of these two modeling approaches was examined, first by deriving corresponding linear system models from governing equations of simple advection-dispersion models. Later, the compatibility was further demonstrated by applying these two modeling approaches in the simulation of solute transport in a field soil. It was found that the linear system approach can be used as an alternative technique in water quality modeling. A linear system model, once established for a receiving water, can be readily applied with varying waste input conditions. A linear system model also facilitates the water quality assessment when waste input or system parameters are random functions. (See also W89-03679) (Author's abstract)
W89-03691

ANALYSIS OF HISTORICAL SURFACE WATER ACIDIFICATION IN SOUTHERN NORWAY USING A REGIONALIZED CONCEPTUAL MODEL (MAGIC),
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
G. M. Hornberger, B. J. Cosby, and R. F. Wright.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 127-132, 2 fig, 3 tab, 11 ref.

Descriptors: *Systems analysis, *Acid rain, *Acid streams, *Surface water, *Norway, *Model studies, *Water quality management, *Acidification, Rainfall, Streams, Mathematical models, Catchment areas, Monte Carlo method, Surveys, Distribution, Temporal distribution, Chemical properties, Policy making, Administrative decisions, Decision making.

Most mathematical models of the hydrochemical response of catchments to atmospheric inputs concentrate on short-term (days to seasons) response of individual catchments. Policy decisions regarding regional emissions, however, require evaluation of the response of entire regions over the long term (years to decades). A 'regionalization' methodology was developed that couples a conceptual model of long-term water quality responses to acidic deposition Model of Acidification of Groundwater In Catchments (MAGIC) with Monte Carlo simulation techniques to reproduce the observed distributions of water quality variables derived from regional water surveys. A posteriori analysis of model parameters that result in acceptable fits to observed distributions permits an evaluation of the importance of processes in matching regional variation in water quality and a determination of which combinations of model parameters are appropriate for a given region. Applied to a subset of 208 lakes in southern Norway that were included in a 1974 survey, the regional model indicates that significant acidification (loss of alkalinity in up to 60% of the lakes) occurred in the decades preceding the survey. Modelections for the decade following the survey (1974-1986) predict that no changes in water quality have occurred. (See also W89-03679) (Author's abstract)
W89-03692

INTERACTION BETWEEN WATER QUALITY, ENVIRONMENTAL LEGISLATION, AND ECONOMICS IN A HYPOTHETICAL RIVER BASIN,
Environmental Protection Agency, Seattle, WA. Region X.
J. R. Yearsley.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 195-200, 2 fig, 1 tab, 2 ref.

Descriptors: *Systems analysis, *Water quality, *Legislation, *Economic aspects, *Water quality management, *Environmental policy, *Model studies, Basins, Catchment areas, Water quality, Costs, Political constraints, River basins, Calibrations.

Water quality, environmental legislation, and economic priorities are considered to interact with an ecosystem in a hypothetical river basin. The dynamics of this ecosystem are analyzed using the DYNAMO system language. Nonlinear interactions between the subsystems lead to oscillatory behavior, but the long-term system state is primarily a function of the level of growth. Although the model results are quantitative, its primary utility is for the qualitative assessment of the way in which these feedback relationships and time delays affect environmental (water) quality. No attempt has been made to calibrate or verify the model. Assuming that it does represent important features of water quality planning, it has a number of valuable applications. It is concluded that policies should be developed regarding growth rates, since the effect of growth eventually dominates the results. For those concerned with the development of monitoring and analysis programs, the model provides a means of assessing the value of improved measurement and analysis techniques. (See also W89-03679) (Doria-PTT)
W89-03698

OPTIMIZATION MODELS IN WATER QUALITY CONTROL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Somlyody, and J. Pinter.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 201-210, 16 ref.

Descriptors: *Systems analysis, *Water pollution control, *Optimization, *Model studies, *Water quality control, *Eutrophication, *Nonpoint pollution sources, *Monitoring, Water quality management, Simulation, Water quality, Reviews, Case studies.

Water quality models can be divided into two groups: descriptive simulation and management optimization models. Successful application of a management model depends on factors such as the proper aggregation of processes affecting water quality, the rate of uncertainty and stochasticity, the model formulation and the solution technique selected. Nowadays, a choice of fairly sophisticated optimization techniques is available; however, their use is frequently hindered by lack of information on important problems. In addition, water quality problems often have a soft character as a consequence of which complex methods do not necessarily perform better than simpler ones. In the light of the above, this paper attempts to give an overview of the use and limitations of management models. Three case studies are presented: the eutrophication problem in Lake Balaton; the control of nonpoint source pollution in two small Hungarian watersheds; and the optimization of regional water quality monitoring (Lake Balaton watershed). (See also W89-03679) (Author's abstract)
W89-03699

SIMCAT-A CATCHMENT SIMULATION MODEL FOR PLANNING INVESTMENT FOR RIVER QUALITY,
Anglian Water Authority, Huntingdon (England).
A. E. Warn.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 211-218, 10 ref.

Descriptors: *Systems analysis, *Water pollution control, *Catchment areas, *Model studies, *Planning, *Water quality management, *Rivers, Effluents, Decision making, Administrative decisions, Mathematical models, Computers, Standards, Water quality standards, Statistical analysis, Monte Carlo method, Calibrations, Sampling.

Cleaning up a river can require decisions about hundreds of effluents. The options can be assessed with efficiency by computer-based mathematical models. One such model, called SIMCAT, computes how the quality of river water is affected by effluents. SIMCAT accepts that the water quality standards for rivers and effluents have a proper statistical definition. Monte Carlo Simulation is used to ensure consistency with these standards. SIMCAT includes features which speed up the process of making decisions. Chief of these are automatic facilities both for calibration and the calculation of effluent standards. Full account is taken of the element of chance which is ever-present in data collected by sampling. SIMCAT computes confidence limits for all its results, an attribute which permits its use in the design of sampling programs. (See also W89-03679) (Author's abstract)
W89-03700

DECISION SUPPORT SYSTEM FOR SELECTING EUTROPHICATION CONTROL STRATEGIES,
National Inst. for Water Research, Pretoria (South Africa).
D. C. Grobler, J. N. Rossouw, P. van Eeden, and M. Oliveira.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 219-230, 5 fig, 16 ref.

Descriptors: *Systems analysis, *Water pollution control, *Decision making, *Water quality management, *Eutrophication, *Cost analysis, *Model studies, *Reservoirs, Administrative decisions, Phosphorus, Catchment areas, Fate of pollutants, Water quality, South Africa.

A simple, dynamic reservoir eutrophication model was developed for simulating phosphorus export from drainage basins, the fate of phosphorus in the receiving water bodies, and the eutrophication-related quality of water bodies. The model was incorporated into a decision support system to facilitate its use for predicting the impact of alternative eutrophication strategies on water quality in reservoirs. The output resulting from applying the decision support system to evaluating control strategies becomes one of the inputs to the analytical hierarchy process used for doing benefit/cost analysis to select the control strategy with the highest benefit/cost ratio. This decision support system, together with the Analytical Hierarchic Process, is now being applied in South Africa for selecting eutrophication control measures suitable for particular drainage basins. (See also W89-03679) (Author's abstract)
W89-03701

Field 6—WATER RESOURCES PLANNING

Group 6A—Techniques Of Planning

DECISION SUPPORT SYSTEM FOR WATER MANAGEMENT IN REGIONS WITH INTENSE AGRICULTURE,
Institute for Land and Water Management Research, Wageningen (Netherlands).
P. E. V. van Walsum, and J. Drent.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 231-240, 5 fig, 2 tab, 9 ref.

Descriptors: *Systems analysis, *Water pollution control, *Decision making, *Water management, *Agriculture, *Environmental protection, *Model studies, Administrative decisions, Resources management, Livestock, Cultivation, Cultivated lands, Nitrates, Phosphates, Leaching, Accumulation, Groundwater levels, Groundwater, Protection, Water use, Water supply, Optimization, Linear programming, Simulation, The Netherland.

Authorities in The Netherlands realize that measures are needed for protecting the environment in regions with intensive livestock breeding and with high-intensity land cultivation. In particular, nitrate leaching and phosphate accumulation need to be controlled, as well as the lowering of groundwater levels. A decision support system is presented for aiding the design and evaluation of such measures. An integrated approach is followed. Scenarios can be generated by setting requirements on the indicators for the 'well-being' of the various water users. One of the indicators is left free and gets optimized using (iterative) linear programming. Comprehensive models are used for verifying and more accurately estimating scenarios that seem promising. An interactive system with color graphics has been developed for analyzing the generated scenarios. Application to a pilot region is described. (See also W89-03679) (Author's abstract)
W89-03702

OPTIMAL CONTROL OF SALTWATER INTRUSION: THE YUN LIN BASIN, TAIWAN,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, B. A. Finney, and P. L.-F. Liu.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 241-250, 2 fig, 2 tab, 28 ref. NSF Grants CEE 83-01230, INT- 8203044.

Descriptors: *Systems analysis, *Saline water intrusion, *Taiwan, *Water quality management, *Planning, *Model studies, *Groundwater, *Optimization, Hydraulics, Interfaces, Saline-freshwater interfaces, Finite difference methods, Pumping, Recharge, Groundwater depletion, Groundwater level, Groundwater recharge, Algorithms.

A planning model is presented for the optimal control of seawater intrusion in regional groundwater systems. The management model is structured as a problem in optimal control. The hydraulic response equations, which are developed from continuity principles, relate the movement of the interface to the magnitude and location of groundwater pumping and recharge. Finite difference methods are used to approximate the solution of the aquifer's response to management strategies. The control problem is solved using the influence coefficient method in conjunction with quadratic programming and with reduced gradient methods in conjunction with a quasi-Newton algorithm. The planning model is applied to the Yun Lin groundwater basin in southwestern Taiwan. Excessive pumping has produced declining water levels, localized land subsidence, and saltwater intrusion in the Peikang area of the basin. The results of the study optimizing groundwater pumping and recharge are presented, along with a discussion of the tradeoffs associated with these decisions and the corresponding movement of the saltwater/freshwater interface. (See also W89-03679) (Author's abstract)
W89-03703

INCORPORATING PARAMETER UNCERTAINTY INTO GROUNDWATER QUALITY MANAGEMENT MODELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
A. J. Valocchi, and J. W. Eheart.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 251-257, 2 fig, 1 tab, 8 ref.

Descriptors: *Groundwater, *Water quality management, *Model studies, *Systems analysis, *Optimization, *Cost analysis, Water quality, Water pollution, Groundwater pollution, Simulation, Linear programming, Wells, Groundwater movement, Transmissivity, Aquifers, Sensitivity analysis.

A simple technique is described for incorporating parameter uncertainty into coupled linear optimization-groundwater simulation models. The problem considered is the design of a purge well system for hydraulic control and removal of a contaminant plume. Steady-state two-dimensional groundwater flow is assumed. The recently presented adjoint state theory is used to compute efficiently the sensitivity of the hydraulic gradient along the plume boundary with respect to small changes in aquifer transmissivity values through the flow domain. Parameter uncertainty is approximately accounted for by constraining the maximum allowable sensitivity. A parametric linear programming technique is used to determine the tradeoff between cost and sensitivity. Results from an application to a hypothetical problem indicate that it is possible to use selective withdrawal and injection to manipulate the groundwater system into states of low sensitivity to parameter changes. (See also W89-03679) (Author's abstract)
W89-03704

REAL TIME OPERATION OF URBAN DRAINAGE SYSTEMS-VALIDITY AND SENSITIVITY OF OPTIMIZATION TECHNIQUES,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5D.
W89-03705

APPLICATION OF SYSTEMS ENGINEERING CONCEPTS TO COMBINED SEWER OVERFLOW CONTROL AT SEATTLE METRO,
Municipality of Metropolitan Seattle-METRO, WA. Technical Services Dept.
For primary bibliographic entry see Field 5D.
W89-03706

PROBLEMS IN MODELLING AND CONTROLLING A WATER CLARIFICATION PROCESS,
Sunderland Polytechnic (England). Dept. of Electrical, Electronic and Control Engineering.
For primary bibliographic entry see Field 5F.
W89-03707

INTERVENTION ANALYSIS TO ESTIMATE PHOSPHORUS LOADING SHIFTS,
Soap and Detergent Association, New York.
K. A. Booman, L. Pallesen, and P. M. Berthouex.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 289-296, 4 fig, 7 ref.

Descriptors: *Systems analysis, *Phosphorus, *Eutrophication, *Pollution load, *Decision making, *Environmental policy, *Model studies, Detergents, Seasonal variation, Administrative decisions, Water quality management.

Phosphate laundry detergents have been banned in the Great Lakes drainage basin and a few other regions of the U.S. New bans are considered from time to time. Any consideration of new bans should include an evaluation of changes that have occurred in past bans. A method is presented for estimating such changes. The method is illustrated with treatment plant influent phosphorus mass loading data. All data series analyzed to date were complicated by drift, large variation, and sometimes seasonal patterns. With such data an appropriate time series model is used to estimate the shift. An ARIMA (0,1,1) model has been used successfully with many data sets. This model seems to be robust and has considerable intuitive appeal. A seasonal component was needed in the model for a few data sets. A Bayesian approach was developed to estimate the shift. The effect of a detergent phosphate ban on influent treatment plant phosphorus load appears to be about 0.3 kg/cap.-yr. (See also W89-03679) (Author's abstract)
W89-03708

MODIFIED SET THEORETIC IDENTIFICATION OF AN ILL-DEFINED WATER QUALITY SYSTEM FROM POOR DATA,
Technische Univ. Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
K. J. Keesman, and G. van Straten.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 297-308, 5 fig, 5 tab, 16 ref.

Descriptors: *System analysis, *Data analysis, *Model studies, *Water quality management, Monte Carlo method, Estimating, Estimating equations.

The Monte Carlo set-theoretic method (MCSM) has been proposed to handle ill-defined systems such as water quality systems. There are, however, two major problems in the MCSM. The first is that it is difficult to actually find the set of acceptable model parameter vectors, especially when the number of parameters is large. The second is that in this form little information is obtained about the quality of the model itself. The modified method proposed in this paper tries to overcome these problems. The first problem is solved by introducing the fuzzy set concept into the MCSM and incorporation of data-analysis techniques. A further modification of the MCSM allows the production of diagnostic information for modelling by means of the min-max estimate and its associated residuals, which are related to a measure of model uncertainty. These modifications lead to a set-up of stepwise applicable procedures providing a comprehensive and systematic approach to the identification problem using Monte Carlo simulation analyses. The potential of the method is demonstrated by applying it to a system identification problem concerning a model of diurnal dissolved oxygen patterns in a lake and data with unknown-but-bounded measurement noise. (See also W89-03679) (Author's abstract)
W89-03709

UNCERTAINTY ANALYSIS IN WATER QUALITY MODELING USING QUAL2E,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
L. C. Brown.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 309-319, 5 fig, 5 tab, 12 ref. US EPA Cooperative agreement CR 811883-01.

Descriptors: *Systems analysis, *Uncertainty analysis, *Model studies, *Water quality management, *Sensitivity analysis, *Monte Carlo method, Mathematical models, Streams, River systems, Hydraulics, Environment, Benthic environment, Analysis of variance, Error analysis, Computer models, Flow, Simulation, Chemical properties, Physical properties, Water quality.

A strategy for incorporating uncertainty analysis techniques (sensitivity analysis, first-order error analysis, and Monte Carlo simulation) into the mathematical water quality model QUAL2E is described. The model, named QUAL2E-UNCAS, automatically selects the input variables or parameters to be altered and stores and manipulates only the output of interest. The modeler is free to select the important output variables and locations in the stream network where uncertainty effects are desired. Applications of the model to the Withlacoochee River in Georgia and Florida demonstrate the importance of hydraulics, forcing functions, and benthal phenomena; the changing sensitivities of input factors at different locations in the stream; and the utility of components of variance analysis. Examples of first order error analysis methods to assess model nonlinearities and the convergence

characteristics of Monte Carlo methods are presented. (See also W89-03679) (Author's abstract)
W89-03710

RECURSIVE RIVER WATER QUALITY ESTIMATION USING ABSTRACT EVOLUTION EQUATIONS IN FUNCTIONAL SOBOLEV SPACES,
Utah Water Research Lab., Logan.
T. B. Hardy, D. S. Bowles, and K. W. Bosworth.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 321-331, 8 fig, 5 tab, 30 ref.

Descriptors: *Systems analysis, *Rivers, *Water quality management, *Forecasting, *Estimating equations, Water quality, Water quality control, Algorithms, Estimating, Optimization, Model testing, Oxygen, Dissolved oxygen, Oxygen demand, Biological oxygen demand.

An alternative approach is presented to the development of algorithms for the simultaneous estimation of system states and model parameters for real-time forecast and control of river water quality. The use of existing state space techniques and Kalman filtering is formulated in terms of constrained optimization by vector space methods in functional Sobolev space. The proposed estimation algorithm for the Recursive Estimation by Vector Space methods (REVS) employs two parallel Kalman filters, one in the state space and one in the parameter space to evolve the first and second moments of the water quality state and parameter estimates while communicating estimation errors by means of a cross-covariance matrix at each time step. This approach is compared to the performance of two different but related mutually interactive state-parameter estimation algorithms, MISP and AMISP. REVS resulted in more stable parameter estimates which converged after three iterations. The variance of the parameter estimates for BOD were reduced and transient fluctuations in parameter estimates during the simulations were reduced. The REVS algorithm appears to provide a stable mutually interactive state-parameter estimation algorithm for real-time forecast and control of river water quality. (See also W89-03679) (Author's abstract)
W89-03711

ON-LINE PREDICTION OF INFLUENT PHOSPHORUS LOAD OF WASTEWATER TREATMENT PLANTS,
Beijing Normal Univ. (China). Research Inst. of Environmental Science.
For primary bibliographic entry see Field 5D.
W89-03714

QUAL2E - A CASE STUDY IN WATER QUALITY MODELING SOFTWARE,
Environmental Protection Agency, Athens, GA.
T. O. Barnwell, L. C. Brown, and R. C. Whittemore.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 377-387, 5 fig, 18 ref.

Descriptors: *Computer models, *Water quality, *Computer programs, *Systems analysis, Water quality management, Model studies, Computers, Simulation, Calibrations, Sensitivity analysis, Fortran.

The series of computer programs known as QUAL-II has a long history in systems analysis in water quality management. The continuing cycle of testing and refinement of the computer program accounts for its many strengths as most of the weaknesses have been uncovered in this process. In its current release, called QUAL2E, the computer program represents the state-of-the-art in a general-purpose steady-state water quality simulation model. The Environmental Protection Agency is using the program as a vehicle for demonstrating systems analysis techniques, including uncertainty analysis methodologies to aid model calibration and gain insights into predictive ability and expert systems technology to develop an intelligent user interface. (See also W89-03679) (Author's abstract)
W89-03718

WATER QUALITY MANAGEMENT IN THE AVE RIVER: FROM RESEARCH TO PRACTICE,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. R. da Costa, and D. P. Loucks.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 389-399, 10 fig, 9 ref.

Descriptors: *Systems analysis, *Water pollution control, *Water quality management, *Ave River, *Portugal, *Rivers, *Model studies, *Computer programs, Planning, International commissions, Flow, Effluents, River basins, Basins, Catchment areas, Prediction, Oxygen demand, Biological oxygen demand, Oxygen, Dissolved oxygen, Maps.

Research, begun in 1983, on the development and implementation of water resources planning methodology in Portugal has had a major impact on water quality management in that country. This research, supported in part by the Science for Stability Program of NATO, has focused its attention on one of the most polluted rivers in the country: the Ave River in Northern Portugal. This paper reviews some of the results of this research project and the impact this work has had in the Ave Basin, and also in the region and country as a whole. New modeling approaches have been developed to handle the dynamic flow regime and uncertain waste input loadings, and institutions have been created to use this methodology for improved planning and management of the river quality. The success of this work has contributed to the more comprehensive approaches to water resources planning now being implemented in the Basin and throughout the country. (See also W89-03679) (Author's abstract)
W89-03719

LOGIC DYNAMIC SIMULATION FOR WATER QUALITY MANAGEMENT,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
M. P. Antunes, M. J. Seixas, A. S. Camara, and M. Pinheiro.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 401-410, 2 fig, 3 tab, 3 ref, append.

Descriptors: *Systems analysis, *Artificial intelligence, *Simulation, *Model studies, *Water quality management, *Oil spills, *Computer programs, Oil pollution, Computers, Computer models, Mathematical models, Path of pollutants.

A new dynamic modelling methodology, SLIN, allowing for the analysis of systems defined by linguistic variables is presented. SLIN applies a set of logical rules avoiding fuzzy theoretic concepts. To make the transition from qualitative to quantitative modes, logical rules are also used. Its potential applications for water quality management are discussed and a simple expert-based model to assess the dispersion of oil in the sea after a shipwreck is formulated. This model is advantageously implemented on PROLOG, a very high level language highly suitable for SLIN applications. (See also W89-03679) (Author's abstract)
W89-03720

LEARNING PRODUCTION SYSTEM FOR THE CONTROL OF URBAN SEWER SYSTEMS,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5D.
W89-03721

RULE-BASED CONTROL SYSTEM FOR THE ACTIVATED SLUDGE PROCESS,
Municipality of Metropolitan Seattle-METRO, WA.
For primary bibliographic entry see Field 5D.
W89-03722

OIL-SPILL RISK ANALYSIS: CENTRAL, WESTERN, AND EASTERN GULF OF MEXICO (PROPOSED SALES 113, 115, AND 116) OUTER CONTINENTAL SHELF,
Minerals Management Service, Reston, VA.
For primary bibliographic entry see Field 5G.
W89-03737

WATER RESOURCES DEVELOPMENT IN LOUISIANA, 1987.
Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
For primary bibliographic entry see Field 2E.
W89-03765

CALIFORNIA SITE MITIGATION DECISION TREE PROCESS: SOLVING THE 'HOW CLEAN SHOULD CLEAN BE' DILEMMA,
California Dept. of Health Services, Sacramento.
D. J. Leu, and P. W. Hadley.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 67-97, 14 fig, 1 tab, 6 ref.

Descriptors: *Waste management, *California, *Decision making, *Cleanup operations, *Management planning, *Water pollution treatment, Risk analysis, Regulations.

The California Site Mitigation Decision Tree Manual has been created as a technical guidance document to assist project managers in making decision that have a strong analytical basis and technical merit. The process specified in the document was designed to be flexible in application. The decision-branching format allows one to quickly identify the pathways of exposure that must be characterized for each site. Simple sites generally require simple approaches; complex sites require more complex detailed multipathway analyses. To facilitate a scientifically based decision process the decision tree incorporates a series of unique aspects. First, it requires a multimedia approach to site characterization and the establishment of cleanup criteria. Second, it identifies the specific parameters for which data must be collected. Third, it identifies the preferred data gathering, handling, and analytical techniques that should be used. Fourth, it establishes statewide, health-based criteria called applied action levels that are specific to particular substances, media, and biologic receptors. They define an exposure level in which no observed adverse effect would be found. Fifth, the decision tree process also allows one to set different cleanup levels for a particular site, a capability that reflects the different degrees of effectiveness of various remedial action combinations. Using the process the project manager is in a position to select the final cleanup solution that best suits the condition of the particular site. (See also W89-03783) (Lantz-PTT)
W89-03786

ESTIMATING HEALTH RISKS AT HAZARDOUS WASTE SITES: DECISIONS AND CHOICES DESPITE UNCERTAINTY,
ENVIRON Corp., Washington, DC.
R. G. Tardiff, and M. Gough.
IN: Hazardous Waste Site Management: Water Quality Issues. Report on a Colloquium Sponsored by the Water Science and Technology Board. Colloquium 3. February 19-20, 1987. p 152-176, 4 tab, 6 ref.

Descriptors: *Public health, *Hazardous wastes, *Management planning, *Risk analysis, *Waste disposal, Toxicity, Biological studies, Research priorities.

Quantitative risk assessment is the only method currently available to estimate risks from waste sites. Both the underlying data about toxicity and methods for extrapolation have greater or lesser amounts of uncertainty. On a more positive note the demands of risk assessment are forcing the development of standardized data bases for health effects; they are also contributing to the develop-

ment of extrapolation methods. Nevertheless, uncertainties must always be considered and conveyed to the decisionmaker so that the strengths and limitations of the risk estimates are appropriately considered in selecting risk management approaches. The most pressing need is for more biologic information to guide extrapolation methods. In part,that information will come from standard toxicologic tests of substances present in waste sites, but more fundamental research is probably the real key to improvement. Research on biologic mechanisms, shared and unshared between test animals and humans, needs considerable emphasis. Along with such data and information will come increasing opportunities for interactions among biologists, statisticians, risk assessors, and decisionmakers. The fostering of those interactions is important to the proper use of vital information and to direct research in obtaining that information. (See also W89-03783) (Lantz-PTT)
W89-03791

REGIONAL APPROACH FOR ASSESSING ATTAINABLE SURFACE WATER QUALITY: AN OHIO CASE STUDY,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W89-03893

DEVELOPMENTS AND POSSIBILITIES OF OPTIMIZATION MODELS,
Istituto di Ricerca sulle Acque, Rome (Italy).
M. Benedine.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 329-358, June 1988. 11 fig, 2 tab, 65 ref.

Descriptors: *Optimization, *Decision making, *Management planning, *Model studies, *Water resources development, Hydrologic models, Water supply requirements, Computer models, Mathematical models, Literature review.

The success experienced in other fields suggested the use of optimization models in the field of water problems. They are applicable to the decision-making process when planning and operating complex water-resource systems. A review of the most common optimization procedures is presented, aimed at pointing out their main characteristics. The effectiveness and the capability of an optimization method are primarily related to subjective preferences and to the specific conditions of the problem under investigation. The method selected should be a computationally feasible solution, assure the highest practical efficiency, provide the quantification of the trade-offs among the different objectives, and provide the largest amount of detail for any solution proposed to facilitate the decision-making process. (White-Reimer-PTT)
W89-04274

IRRIGATION PROJECT APPRAISAL: OUTLINE OF PRINCIPLES,
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 3F.
W89-04275

ROLE OF HYDROLOGICAL FORECASTS AND RIVER FLOW MODELLING IN RATIONAL AGRICULTURAL WATER MANAGEMENT IN THE PERSPECTIVE OF A CLIMATE CHANGE - A CASE STUDY OF THE RIVERS UPPER NILE AND NIGER,
World Meteorological Organization, Geneva (Switzerland). Dept. of Hydrology and Water Resources.
J. Nemec.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 383-392, June 1988. 2 fig, 2 tab, 8 ref.

Descriptors: *Model studies, *Hydrologic models, *Climatology, *Water management, Hydrological forecasts, Agricultural hydrology, Nile River, Niger River, Africa, River basins, Computer models.

The possible impact of climatic changes, particularly the role of CO2 and other greenhouse effect gases, on water resources and on agricultural management is discussed in regard to the use of hydrological and water management models to predict the consequences of these changes. It is proposed that real-time hydrological forecasting systems, able to produce forecasts with long, medium and short lead times, are one of the most effective measures to offset possible negative effects of the climate change, by increasing the effectiveness of storage management. These propositions are documented using models of the Lake Victoria basin, River Nile, and a hydrological forecasting system on the River Niger. This model consists of 37 FORTRAN programs divided into three main components: (a) a catchment component; (b) a lake water balance component; and (c) a channel component. It is proposed that it is important to develop a simulation model of the whole River Nile, together with a real-time forecasting system on the river in order to efficiently operate existing and future storages, and to supplement the River Niger forecasting system with a physically-based, causal, rainfall-runoff model of the basin in order to explore the impact of possible climate change on agriculture and irrigation. (White-Reimer-PTT)
W89-04277

OPTIMISATION AND UPRATING OF ACTIVATED SLUDGE PLANTS BY EFFICIENT PROCESS DESIGN,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5D.
W89-04456

6B. Evaluation Process

GRAPH MODEL APPROACH TO ENVIRONMENTAL CONFLICT RESOLUTION,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
For primary bibliographic entry see Field 6A.
W89-03460

ENGINEERING AND ENVIRONMENTAL GEOLOGY OF THE INDIAN WELLS VALLEY AREA,
Naval Weapons Center, China Lake, CA.
For primary bibliographic entry see Field 4C.
W89-03742

PUBLIC TUBEWELL DEVELOPMENT IN THE STATE OF UTTAR PRADESH, INDIA,
For primary bibliographic entry see Field 3F.
W89-03796

CULTIVATING CONSUMER CONFIDENCE THROUGH COMMUNICATION,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 7C.
W89-03884

ECONOMIC EVALUATION OF SUGAR CANE PRODUCTION UNDER DIFFERENT WATER SUPPLY SYSTEMS IN THAILAND,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 3F.
W89-04210

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMIC VALUATION OF ACIDIC DEPOSITION DAMAGES: PRELIMINARY RESULTS FROM THE 1985 NAPAP DAMAGE ASSESSMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W89-03382

BAY AND THE ECONOMY,
For primary bibliographic entry see Field 2L.
W89-03724

1988 NATIONAL WATER RATE SURVEY,
Young (Arthur) and Co., Charlotte, NC.
G. A. Raftelis.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 9, p 78-81, September 1988. 5 tab, 1 fig.

Descriptors: *Water rates, *Surveys, *Water management, *Economic aspects, Water costs, Water use, Cost analysis, Management planning.

Developing an effective rate structure for recovering service costs is necessary for operating a water utility on a self-sustaining basis. Considerations in selecting an appropriate rate structure, the process of establishing revenue requirements and determining rates, and considerations in comparing water rates are discussed. Additionally, an overview of a 1988 survey of US water rates is presented. Results of the rate survey were compiled in the fall of 1987; 112 communities participated. Regional populations served, the inside-of-city water charges for each community, and the types of rate structures used are listed. Many factors influence water pricing, so care should be taken in drawing conclusions regarding water operations in a particular community. However, comparisons among communities may signal to water utility management that there should be reasons why one community's rates are higher or lower than another's. Analyzing the reasons for these differences may provide insight into the effectiveness of water operations. (VerNooy-PTT)
W89-03879

EVALUATING CONTRACTS IN TERMS OF PUMP EFFICIENCY,
For primary bibliographic entry see Field 6C.
W89-04022

EVALUATING CONTRACTS IN TERMS OF PUMP EFFICIENCY,
J. Nicholson.
Water Engineering and Management WENMD2, Vol. 135, No. 9, p 30-31, September 1988.

Descriptors: *Evaluation, *Pump tests, *Pumps, *Contracts, *Cost analysis, Costs, Economic aspects, Planning, Operating costs.

Any pump selection process should include careful evaluation of a number of factors and conditions that add up to real operational efficiencies. Limiting all other criteria to focus solely on purchase price in the late stages of bidding disserves the interest of the customer who has expended engineering expense to obtain an exact measure of quality. Generic terms dealing with efficiency are defined, including bowl, ideal, or lab efficiency; field or wire-to-wire efficiency; operating efficiency; and design efficiency. The real value of operational savings is discussed to illustrate how tens of thousands of dollars can be lost over a period of years through inadequate attention to efficiency in the pump selection process. An example is provided of a weighted bid evaluation based on field efficiency. It is concluded that contracts can be evaluated and weighted for efficiency with considerably less effort than evaluating and weighting for minority and small business participation. (Doria-PTT)
W89-04022

6D. Water Demand

USE OF WATER IN ARKANSAS, 1985,
Geological Survey, Little Rock, AR. Water Resources Div.
T. W. Holland.
Arkansas Geological Commission Water Resources Summary Number 16, 1987. 27p, 16 fig, 9 tab, 17 ref.

Descriptors: *Water use, *Arkansas, *Hydrologic data collections, Data collections, Agriculture, Municipal water, Irrigation, Industrial water, Hydroelectric power, Groundwater mining.

The water use categories considered and the total quantity of water used in each category of the 1985 Arkansas water use inventory are public supply, 261 million gallons/day (mgd); industrial (self-supplied), 172 mgd; domestic (self-supplied), 60.4 mgd; agriculture (irrigation), 3,870 mgd; agriculture (non-irrigation), 384 mgd; mining, 3.28 mgd; commercial 7.97 mgd; electric-energy generation, 61,000 mgd. These data are tabulated by county, by hydrologic unit, and by source. Water withdrawals during 1985 were approximately 65,800 mgd, of which groundwater sources provided 3,810 mgd and surface water sources supplied 62,000 mgd. The largest use of water was for electric-energy generation, which accounted for 93% of the total withdrawals. Excluding hydroelectric diversions, 1985 surface water use was 2,050 mgd, and 1985 groundwater use was 3,810 mgd. Five percent (3,210 mgd) of the total withdrawals was consumed. (Author's abstract)
W89-03763

ESTIMATES OF CONSUMPTIVE USE AND GROUND-WATER RETURN FLOW USING WATER BUDGETS IN PALO VERDE VALLEY, CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
S. J. Owen-Joyce, and S. L. Kimsey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4070, 1987. 50p, 20 fig, 11 tab, 11 ref.

Descriptors: *Consumptive use, *Hydrologic budget, *Return flow, *Groundwater recharge, *Colorado River, *Irrigation water, Agricultural hydrology, California, Palo Verde dam, Groundwater storage, Drainage ditches, Drainage water.

Palo Verde Valley, California, is an agricultural area in the flood plain of the Colorado River where irrigation water is diverted from the river and groundwater is discharged to a network of drainage ditches and (or) the river. Consumptive use by vegetation and groundwater return flow were calculated using water budgets. Consumptive use by vegetation was 484,000 acre-ft in 1981, 453,600 acre-ft in 1982, 364,400 acre-ft in 1983, and 374,300 acre-ft in 1984. The consumptive-use estimates are most sensitive to two measured components of the water budget, the diversion at Palo Verde Dam and the discharge from drainage ditches to the river. Groundwater return flow was 31,700 acre-ft in 1981, 24,000 acre-ft in 1982, 2,500 acre-ft in 1983, and 7,900 acre-ft in 1984. The return-flow estimates are most sensitive to discharge from drainage ditches; various irrigation requirements and crop areas, particularly alfalfa; the diversion at Palo Verde Dam; and the estimate of consumptive use. During increasing flows in the river, the estimate of groundwater return flow is sensitive also to change in groundwater storage. Change in groundwater storage was estimated to be -5,700 acre-ft in 1981, -12,600 acre-ft in 1982, 5,200 acre-ft in 1983, and 11,600 acre-ft in 1984. Changes in storage can be a significant component in the water budget used to estimate groundwater return flow but is negligible in the water budget used to estimate consumptive use. Change in storage was 1 to 3% of annual consumptive use. Change in storage for the area drained by the river ranged from 7 to 96% of annual groundwater return flow during the 4 years studied. Consumptive use calculated as diversions minus return flows was consistently lower than consumptive use calculated in a water budget. Water-budget estimates of consumptive use account for variations in precipitation, tributary inflow, river stage, and groundwater storage. The calculations for diversions minus return flows do not account for these components, which can be large enough to affect the estimates of consumptive use. (Author's abstract)
W89-03792

ECONOMETRIC STUDY OF INDUSTRIAL WATER DEMANDS IN BRITISH COLUMBIA, CANADA,
British Columbia Univ., Vancouver. Dept. of Economics.
S. Renzetti.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1569-1573, October 1988. 3 tab, 10 ref.

Descriptors: *Water demand, *Canada, *Industrial water, *Water supply, *Econometrics, Mathematical models, Expenditures, British Colombia.

Despite the importance of water use by the industrial sector, little economic research has been conducted to study the nature of industrial water demands. A relatively simple model of input demands is used to test whether industrial water use is sensitive to changes to input prices or the level of production. Demands for four aspects of industrial water use (intake, treatment prior to use, recirculation, and treatment prior to discharge) are estimated as a system of simultaneous equations. The data set is a 1981 cross section of firm level observations on water use and expenditure. Empirical results are reported for four manufacturing subgroups: petrochemicals, heavy industry, forest industry, and light industry. Intake price elasticities range from -0.12 to -0.54 and intake elasticities with respect to the level of output range from 0.76 to 1.90. The cross price elasticity between intake and recirculation is positive for all subgroups (indicating substitutability) and ranges from 0.14 to 0.26. (Author's abstract)
W89-03797

DEPENDABLE YIELD EVALUATIONS: HOW MUCH WATER IS REALLY THERE,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 4A.
W89-03877

EFFECTS OF CONSERVATION ON DAILY WATER USE,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W89-03878

ESTIMATED WATER USE IN SOUTH DAKOTA, 1985,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04034

PUMPAGE DATA FROM PUBLIC-SUPPLY WELLS AT ANCHORAGE, ALASKA, 1957-85.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04085

COMPILATION AND ESTIMATION OF PUMPAGE FOR THE MAJOR GROUNDWATER USERS IN THE COASTAL PLAIN OF ALABAMA, 1960-85,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. E. Crownover.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-547, 1987. 35p, 2 fig, 2 tab.

Descriptors: *Groundwater, *Water use, *Alabama, Pumpage, Southeastern Coastal Plain Aquifer System.

This report provides a compilation and estimation of groundwater pumpage for selected public systems located in the Southeastern Coastal Plain aquifer system in Alabama. The groundwater pumpage use and the source of data are given for each year during the period of 1960-85. (USGS)
W89-04153

WATER USE DATA COLLECTION PROGRAMS AND REGIONAL DATA BASE OF THE GREAT LAKES-ST. LAWRENCE RIVER BASIN STATES AND PROVINCES,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-04154

EXPERIENCE IN USING THE WATER RESOURCES OF THE NOVOSIBIRSK RESERVOIR,
V. P. Bityukov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 17-22, July 1988. 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 18-22, January 1988.

Descriptors: *Dam effects, *Water demand, *Reservoirs, *Competing use, *Soviet Union, *Water resources development, Water shortage, Novosibirsk Reservoir, Hydroelectric power, Conferences, Management planning, Ob River, Navigation.

The Ob River was dammed in 1956 to form the Novosibirsk Reservoir (Soviet Union), which impounds 8.8 billion cu m of water and has a useful capacity of 4.4 billion cu m. The water resources of the reservoir are used for power production, navigation, water supply, fishery, and agriculture (irrigation). These uses compete for water and the conflicts are likely to become worse in the future, particularly if dry years as serious as 1900 and 1901 were to recur. During the 30-yr period of operation of the hydro development, changes have occurred in the natural conditions on the stretch of the Ob River adjacent to the hydro development. The most serious of these is the deformation of the river channel in the lower pool of the hydrostation, which has caused a considerable shortage of water resources in years with low runoff. Over the period 1975-1986 a series of conferences and seminars explored the anticipated future problems in operating the reservoir to protect the rights of interested parties while preserving the water quality and habitats in the reservoir. Several of the emerging water resources issues and the plans of the water-management complex for dealing with each are discussed. (Rochester-PTT)
W89-04194

RECREATIONAL USE OF THE RESERVOIRS OF HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 2H.
W89-04224

STEP-AHEAD STATE FORECASTING USING STREAMFLOW OBSERVATIONS,
Ente Nazionale per l'Energia Elettrica, Mestre (Italy). Servizio Idrologico.
G. Ceccone.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 169-183, June 1988. 10 fig, 7 tab, 6 ref.

Descriptors: *Streamflow, *Water-supply management, *Water demand, *Statistical methods, *Hydrologic data, Step-ahead state forecasting, Water supply, Forecasting, Future planning, Management planning, Optimization, Value, Frequency analysis, Po River.

A simple method of forecasting the future monthly degree of satisfaction of an assigned water demand instead of the future supply is presented. The supply series Q(t) is transformed into a state series S(t), each state being defined by the ordinal number j=1, J of the interval containing the value of supply, the intervals being defined by assigned J-1 water demand levels. Small collections of c=1,2,3,4 successive states are considered to form representational seasonal objects O sub k(t)= (S(t-c+1);..;S(t)) which define local terminal-month k shapes within the state series. For every month k, the frequency of occurrence of each object in the historical series is used to select dominant objects, which provide the decision criterion for the future state value in time t, when the c-1 states S(t-c+1),...,S(t-1) are known. Monthly data from the Po river watershed are used to simulate step-ahead state forecasting with various values of J and c. A thirty year span of the historical record was used to estimate the dominant objects, the remaining data being used to make step-ahead state forecast-

ing. As a result, the comparison of actual and forecasted states shows the existence of an optimal value of c for J=2,3,...5, which maximizes the total number of correct state forecasts. The application of the method, for both constant and seasonal water-demand levels, to two streamflow series with different characteristics of persistence shows the convenience of considering objects with c=2 consecutive states. The increase in the number of correct state forecasts from the c=1 to the c=2 model is about 5% for the constant demand, and 10-40% for the seasonal demand. (Author's abstract)
W89-04261

CONJUNCTIVE USE OF WATER FOR IRRIGATION, MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN ISTRA, YUGOSLAVIA,
Rijeka Univ. (Yugoslavia). Faculty of Civil Engineering.
Z. Kos.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 211-224, June 1988. 5 fig, 1 tab, 3 ref.

Descriptors: *Water management, *Industrial water, *Yugoslavia, *Regional planning, *Municipal water, *Irrigation requirements, *Water demand, *Reservoir storage, *Groundwater management, *Conjunctive use, Istra peninsula, Long-term planning, Water storage, Soil types, Water shortage, Water deficit, Reservoir construction.

The Istra peninsula in north-west Yugoslavia covers an area of 3100 sq km and has about 200,000 inhabitants. The extensive plains with a thick top soil of terra rossa and alluvial soils are suitable for high-yield crop development, particularly orchards and vegetables. However, in spite of relatively high rainfall a lack of water for all needs exists due to unfavorable orographic and geologic conditions that prevent the water from being stored as a supplementary source. Comprehensive investigations indicated the most serious limitation for intensive agricultural development is the deficit of water in the growing season. The consideration of a proposed plan for long-term water supply for irrigation, a significant change in the traditional cropping pattern, and the hydrotechnical solution of constructing a dozen storage reservoirs will meet the regions water needs up to the year 2015. Due to the exhaustion of underground water resources that the planned water-resources systems will meet the water needs for all users (population, tourism, industry, and agriculture) over the next fifty-year period primarily by constructing appropriate storage basins for storing surface water. (White-Reimer-PTT)
W89-04264

MODELING DERIVED DEMAND FOR IRRIGATION WATER,
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
J. Kindler.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 403-410, June 1988. 3 fig, 11 ref.

Descriptors: *Model studies, *Irrigation, *Water demand, Demand modeling, Irrigation efficiency, Irrigation requirements, Mathematical modeling.

Demand modeling is an attempt to identify principal demand-generating factors and to model how these factors influence each other and the demand itself. The essence of water-demand modeling is that the models contain the price of water as a variable. Analysis of efficiency in the use of water for irrigation can be facilitated by demand-modeling, which is an attempt to identify principal demand-generating factors and to show how these factors influence each other and the demand itself. One of the fundamental difficulties in demand-modeling is scarcity of a sufficient data base concerning irrigation water withdrawals under different physical, economic and institutional conditions. Man's cognitive capacities, learning abilities and his rates of information processing, these psychological variables are disregarded in the current demand models. The emerging interactive approaches to modeling may overcome at least some of these limitations. Reliable water-demand models which show how irrigation-water withdrawals will change in response to various prices, regulations, technological innovations, and other factors are important in the development and use of water resources. (White-Reimer-PTT)
W89-04279

GROUNDWATER RESOURCES IN THE NORTH CHINA PLAIN,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2F.
W89-04324

WATER RESOURCES AND THEIR UTILIZATION IN SASKATCHEWAN, CANADA,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 228-233, January 1988. 4 fig, 2 tab, 10 ref. NSERC Grant 1412.

Descriptors: *Water use, *Saskatchewan, Canada, *Fishing, *Mineral industry, *Hydroelectric power, *Recreation, Crustaceans, Shrimp, Lakes, Streams, Geography, Flow rates, Reservoirs, Fish, Minerals, Pulp and paper industry, Sodium sulfate, Sodium, Magnesium, Boating, Swimming, Birds, Waterfowl, Hunting.

Saskatchewan has as great a variability of lake water salinity as any geographic region of comparable size in the world. Most of the lakes (83,000) are found in the Precambrian Shield and are freshwater. A few of these lakes are larger than 1000 sq km, but most lakes are very small. Another 10,000 lakes occur on glacial till south of the Shield. While many of these lakes are fresh some are subsaline such as those in the Qu'Appelle River valley. Streams are most prevalent on the Precambrian Shield with large flows occurring in the Churchill and Fond du Lac rivers. In the southern half of the province the North and South Saskatchewan Rivers flow through but most of their waters are derived from the Rocky Mountains in Albeta. Large reservoirs have been constructed on the Churchill (Whitesand), South Saskatchewan (Lake Diefenbaker) and Saskatchewan (Tobin Lake, Codette Lake) Rivers to develop hydroelectricity. During 1985 they produced 1.943 million megawatt hours of energy providing 16.4% of Saskatchewan power production. Thermal power production utilizes water for cooling but the amounts utilized are relatively small. Lake Diefenbaker also supplies irrigation water to about 38,000 ha of farmland. Small dams on other systems, maintain lake levels so water can be used for municipal supplies and irrigation. About 100,000 ha are now irrigated in Saskatchewan. A potential for another 108,000 ha exists. Other water uses include sport fishing, which involves 250,000 people; brine shrimp production; mineral production (mostly sodium sulfate, used in the pulp and paper industry); and recreation, including fishing, boating, and water skiing. Lakes are also widely used by waterfowl, and extensive hunting occurs each fall. (Doria-PTT)
W89-04502

WATER APPEARANCE AND RECREATIONAL USE OF 10 LAKES OF THE NORTH ISLAND (NEW ZEALAND),
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2H.
W89-04541

6E. Water Law and Institutions

ALTERNATE CONCENTRATION LIMIT GUIDANCE: BASED ON SECTION 264.94 (B) CRITERIA. PART II: CASE STUDIES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W89-03369

SCIENCE, ENGINEERING, AND THE LAW ON WESTERN SUNBELT RIVERS,
Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 3, p 221-225, May/June 1988. 41 ref.

Descriptors: *Water law, *Water rights, *Rivers, *Legal aspects, *Arid-zone hydrology, *Engineering, Sunbelt, Geomorphology, Geologic history, Humid areas, Planning, Policy making, Boundary disputes.

The Sunbelt lies in the region south of the eight-inch annual snowfall line; from the hydrologic perspective, the Sunbelt has two parts, a western arid section and an eastern humid section. In the period from 1870 to 1910, western Sunbelt experiences played significant roles in development of the sciences of hydrology and geomorphology. These early efforts emphasized understanding long-term (thousands to millions of years) landscape development, however; and when hydrology and geomorphology turned to shorter-term processes of interest to the planner and policymaker, humid-region inputs became dominant. As scientific generalization become well established, they become part of engineering principles and applications. Because geomorphologic and hydrologic theories to explain river behavior are not well-suited to the western Sunbelt, the engineering approaches derived from them are not readily adapted to the region. Most American environmental law is developed from English common law as applied in the humid northeastern United States. Even the seemingly simple approach of using a river course as a political boundary becomes difficult in the western Sunbelt. The legal and planning communities can improve their contributions to dealing with western Sunbelt rivers by developing case law on local western conditions rather than by arbitrarily importing concepts from other regions. (Shidler-PTT)
W89-03418

INDIAN WATER RIGHTS,
Nevada Univ., Reno. Dept. of Agricultural Economics.
D. R. Franklin, and J. J. Jacobs.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 3, p 234-238, May/June 1988. 9 ref.

Descriptors: *Indian water rights, *Water rights, *Indian reservations, *Water law, Legal aspects, Reservation doctrine, Irrigable land, Administration, Water resources development, Alternative planning, Cost-benefit analysis, Irrigation programs, Employment.

In 1908, the Supreme Court ruled that the United States did implicitly reserve water in sufficient quantity to meet the primary purpose of the Fort Belknap Reservation in Montana. The Federal Reserve Doctrine has been firmly established through case law. However, many questions regarding the quantification and administration of federal reserved water rights remain unanswered. With regard to quantification, the quantity of water in Indian water rights cases has been tied to the primary purpose of the reservation; it is that quantity of water needed to meet the practicably-irrigable acreage on the reservation. In only a few cases have the courts addressed the difficult issue of administering Indian water rights. The courts have allowed the transfer of Indian water rights within reservation lands to non-Indians. Finally, the question of alternatives to improving the well-being of Indians other than water development has never been considered. Benefit-cost analyses of irrigation projects reveal the relatively few jobs provided and the small increase in income after paying for operation and maintenance costs, let alone repayment of the capital investment. Alternative investments should be investigated as a means to improve the standard and quality of life on Indian reservations. Regardless of the granting of water rights, the investment of public funds to develop these rights for irrigation would have only minor impact on employment and income and, thereby, the quality of life on Indian reservations. (Shidler-PTT)

W89-03419

NATION'S WATER QUALITY: INTO THE 21ST CENTURY,
Environmental Protection Agency, Washington, DC. Municipal Facilities Div.
For primary bibliographic entry see Field 5G.
W89-03670

SELECTED MUNICIPAL SLUDGE TOPICS.
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W89-03672

MICHIGAN'S PROCESS FOR REGULATING TOXIC SUBSTANCES IN SURFACE WATER PERMITS,
Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
For primary bibliographic entry see Field 5G.
W89-03674

DEVELOPING MANAGEMENT POSITIONS FOR ACIDIC EMISSION REDUCTION NEGOTIATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-03685

ENVIRONMENTAL PROJECTS: VOLUME 5. PART ONE: STUDY OF SUBSURFACE CONTAMINATION, PART TWO: GUIDE TO IMPLEMENT ENVIRONMENTAL COMPLIANCE PROGRAMS.
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 5B.
W89-03743

INTERNATIONAL METEOROLOGICAL INSTITUTE IN STOCKHOLM ANNUAL REPORT, JULY 1986-JUNE 1987.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
Available from the National Technical Information Service, Springfield, VA 22161, as N88-20755. Price codes: A04 in paper copy, A01 in microfiche. October 1987. 51p, 3 fig.

Descriptors: *Institutions, *Research facilities, *Meteorology, Sweden, Fluid dynamics, Geochemistry, Biochemistry, Atmospheric physics, Publications.

The International Meteorological Institute in Stockholm (IMI) was created in 1955 by decision of the Swedish Parliament with the objective 'to conduct research in meteorology and associated fields and to promote international scientific cooperation within meteorology'. The most important function of the Institute is to provide possibilities for foreign scientists to work in Sweden for varying periods of time in close collaboration with their Swedish colleagues. The research work at the International Meteorological Institute is organized in three sections: dynamic meteorology and geophysical fluid dynamics; chemical meteorology and biogeochemistry; and atmospheric physics. This annual report summarizes the year's research activities in these fields, as well as international activities and finances. Visiting scientists are also listed as are publications and reports produced. (Lantz-PTT)
W89-03754

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-03784

HOW CLEAN IS CLEAN. THE NEED FOR ACTION,
General Electric Co., Fairfield, CT.
For primary bibliographic entry see Field 5G.
W89-03787

HOW CLEAN IS CLEAN. AN ENVIRONMENTALIST PERSPECTIVE,
Environmental Defense Fund, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-03788

GROUND WATER CONTAMINATION ISSUES IN SANTA CLARA COUNTY, CALIFORNIA: A PERSPECTIVE,
Santa Clara Valley Water District, San Jose, CA.
For primary bibliographic entry see Field 5G.
W89-03789

INTERNATIONAL INSTITUTE FOR LAND RECLAMATION AND IMPROVEMENT: ANNUAL REPORT 1987.
International Institute for Land Reclamation and Improvement (ILRI), Wageningen, The Netherlands. 1988. 112p.

Descriptors: *Land reclamation, *Public health, *Irrigation programs, *Wells, *Water supply development, *Indonesia, *India, Organizations, Research facilities, Publications.

The International Institute for Land Reclamation and Improvement is an organization which collects and disseminates information and conducts research on land and water problems in developing countries. Their 1987 Annual Report contains articles on malaria control in Indonesia and irrigation management and public well development in India. Besides these articles, the report also contains sections on Consultancy and Training, Publishing and Information, and Organization. (See W89-03794 thru W89-03796) (Fish-PTT)
W89-03793

IRRIGATION WATER MANAGEMENT IN THE TUNGABHADRA SCHEME, INDIA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 3F.
W89-03795

CAN PUBLIC NOTIFICATION WORK FOR YOU,
J. W. Hoffbuhr.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 37-38, October 1988. 1 tab.

Descriptors: *Communication, *Public relations, *Regulations, Water management, Public policy, Attitude, Drinking water.

Public notification requirements of the Safe Drinking Water Act are viewed by some water utility managers as negative and unnecessary. Regulations are explained and utility managers are advised how to prepare public notices, emphasizing how such notices can have positive effects if used to increase consumer awareness of the challenges and needs of water utilities. The tone of a public notice has a major effect on the public's perception of the water system. Public notices certainly can be a negative experience if they are the only time consumers hear about their drinking water. Water suppliers need to shed the image of 'silent service' and make an deliberate effort to inform consumers about the water system, how rates are established, the true cost of providing safe drinking water, and the requirements set forth in the Safe Drinking Water Act. (Vernooy-PTT)
W89-03885

MANAGEMENT ASPECTS OF PUBLIC NOTIFICATION REQUIREMENTS,
Ann Arbor, MI.
W. H. Abbott.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 39-41, October 1988. 1 tab.

Descriptors: *Communication, *Public relations, *Regulations, *Management planning, Water management, Public policy, Drinking water.

New public notification requirements will challenge many US water utilities to re-examine public information attitudes and practices. These requirements and the industry's reactions to them are discussed and water utility managers are encouraged to take a proactive position toward keeping customers informed and educated on a broad range of drinking water issues. A successful public information program implemented in 1977 by the Ann Arbor (Mich.) Utilities Department is highlighted. Information, which is always short and easy to read, is routinely printed on the reverse side of postcard-size quarterly utility bills. Competition for this space has increased as other city departments and agencies submit copy in hope of having it used. This broad interest in using the space, along with positive comments from customers, indicates that the items are well read. (Author's abstract)
W89-03886

RISK COMMUNICATION: AN AVENUE FOR PUBLIC INVOLVEMENT,
New Jersey Dept. of Environmental Protection, Trenton. Office of Science and Research.
J. A. Shaw, and J. Herb.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 42-44, October 1988. 6 ref.

Descriptors: *Communication, *Public participation, *Public relations, *Risks, Evironmental policy, Regulations, Decision making, New Jersey.

Government agencies dealing with environmental issues have traditionally excluded the public from the regulatory decision-making process, opting instead to solicit public comment mainly after decisions have been made. Faced with increasing health threats from environmental contaminants and fearing a loss of control over decisions that affect their lives, the public is demanding to be involved throughout the regulatory process. Recent research on risk communication offers regulatory agencies a framework for developing new approaches to public involvement. One example of such framewaork is the Risk Communication Unit (RCU) of the New Jersey Department of Environmental Protection (NJDEP) Division of Science and Research. Its responsibilities include undertaking research that is specifically designed to identify effective strategies for NJDEP interaction with citizens and communities, testing and developing those strategies through case studies, integrating effective strategies into a comprehensive protocol, assessing the protocol's effect on agency policy, and protocol's effect on agency policy, and helping integrate successful strategies into NJDEP programs. An initial RCU project was a two-year survey of public perceptions of environmental hazards, which resulted in the NJDEP gaining a new awareness of the considerable growth in the public's level of sophistication and overall knowledge of risks. A second RCU project developed a risk communication manual designed to assist management and staff in focusing on risk communication issues. Shared control of the process can help shift the focus from process to the issues and make it possible to find mutually acceptable solutions that are reached through a fair and equitable process. (Vernooy-PTT)
W89-03887

EXTENSION'S ROLE IN SOIL AND WATER CONSERVATION,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 4D.
W89-03892

CHALLENGE OF A VITAL RESOURCE ALONG THE ATCHAFALAYA,
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6G.
W89-03990

Group 6E—Water Law and Institutions

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1986 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04058

EXTERNALITY AND EQUITY IMPLICATIONS OF PRIVATE EXPLOITATION OF GROUND-WATER RESOURCES,
Institute of Rural Management, Anand (India).
T. Shah.
Agricultural Systems AGSYD5, Vol. 28 p 119-139, 1988. 4 fig, 3 tab, 20 ref.

Descriptors: *Groundwater availability, *Groundwater management, *Economic aspects, *India, Water extraction mechanisms, Pumping, Wells, Water table decline, Saline water intrusion, Drawdown, Aquifers, Coastal aquifers, Irrigation canals.

Private exploitation of groundwater resources has several important effects in India: inequities caused by unequal access, diseconomies caused by clustering of modern Water Extraction Mechanisms and permanent decline in water table due to excessive pumping, seepage of saline water into coastal aquifers due to lowering of groundwater table, and the potential that private Water Extraction Mechanisms offer to mitigate diseconomies in the form of water-logging and build-up of soil salinity in command areas of canals. Unequal rate of water use by owners of modern Water Extraction Mechanisms, coupled with the lack of properly specified property rights on groundwater, enables them to earn a surplus for which they are not obliged to compensate the community. The yield of a well is determined by the ease and speed with which water can move through the aquifer, the drawdown available in the well as a result of pumping, etc. Coastal areas have a very fragile groundwater balance. In coastal aquifers, fresh water with its lower specific gravity floats on a layer of saline water. Lowering of the water table beyond a certain depth leads to the intrusion of sea water into the aquifer. In the command areas of many of India's canal irrigation projects, rising water tables and the build-up of salts in the topsoils have emerged as major social problems. Investments in drainage and canal lining supported by organizational reforms involving greater participation by users in maintenance and management of the systems have been discussed as a feasible solution. Private water extraction capacity in canal commands follows a pattern opposite to what is required to ensure a stable equilibrium in the water table movements. Public control of groundwater resources may, in theory, provide an alternative; however, existing evidence about management capacities available in the third world irrigation systems raises serious doubts about its viability. (Davis-PTT)
W89-04303

6F. Nonstructural Alternatives

EFFECT OF HYDROTECHNICAL CONSTRUCTION ON THE SOIL-COVER COMPLEX OF RIPARIAN TERRITORIES AND NATURE CONSERVATION MEASURES,
For primary bibliographic entry see Field 6G.
W89-04219

6G. Ecologic Impact Of Water Development

COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM WORK PLAN FOR FISCAL YEAR 1988.
Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife.
For primary bibliographic entry see Field 6A.
W89-03335

EFFECTS OF POST-DAM FLOODING ON RIPARIAN SUBSTRATES, VEGETATION, AND INVERTEBRATE POPULATIONS IN THE COLORADO RIVER CORRIDOR IN GRAND CANYON, ARIZONA,
Glen Canyon Environmental Studies, Flagstaff, AZ.
L. E. Stevens, and G. L. Waring.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-183488. Price codes: A06 in paper copy, A01 in microfiche. Terrestrial Biology of the Glen Canyon Environmental Studies, April 15, 1986. 166p, 19 fig, 9 tab, 62 ref, 4 append.

Descriptors: *Glen Canyon Dam, *Dam effects, *Arizona, *Grand Canyon, *Water resources development, *Ecological effects, *Colorado River, *Riparian vegetation, Flooding, Organic matter, Suspended solids, Mortality, Invertebrates, Reservoir operation.

During the 17 years required for the filling off the reservoir behind Glenn Canyon Dam, a new riparian ecosystem became established downriver. Since the reservoir bace full flooding has exerted significant impacts on riparian substrates, riparian plant communities, and invertebrate herbivore populations in the Colorado River riparian corridor in Grand Canyon. Riparian substrates were scoured and leached by flooding in 1983. Base cation concentrations, % organic material, and % silt + clay decreased relative to the substrate surface level following flooding, while pH remained unchanged. Increased % sand in this system implies increased rates of erosion, leaching, and desiccation of beach substrates, conditions which represent a significant decline in habitat quality for existing and future riparian plant life. Flood-induced plant mortality was significant in this system, and reduced riparian plant abundance by more than 50% below the 1,700 cu m/sec stage. Sources of mortality included: (1) removal, which was dependent on plant architecture; (2) drowning/thrashing; and (3) burial beneath newly deposited fluvial sediments. Mortality was strongly differential, with relatively high survivorship of Tamarix chinensis, Salix exigua, and S. gooddingii, and low survivorship of Baccharis spp., Brickellia longifolia, and xeric-adapted species. Flooding did not eliminate any species from this system. In 1983 and 1984 flooding promoted germination of riparian plant seedlings, especially Tamarix and Baccharis; however, recovery of the habitat through recruitment of riparian plants is uncertain. Flooding negatively affected invertebrate herbivore populations on Tamarix and Salix exigua in 1983, but was correlated with an outbreak of Opsius stactogalus on Tamarix in 1984. Flooding also negatively affected terrestrial and fossorial invertebrate populations. Trophic relationships between terrestrial and aquatic components of the riparian ecosystem are complex in this system and are described in relation to suggested changes in the operating criteria of Glen Canyon Dam. (Author's abstract)
W89-03346

MONITORING BIRD POPULATION DENSITIES ALONG THE COLORADO RIVER IN GRAND CANYON,
Glen Canyon Environmental Studies, Flagstaff, AZ.
B. T. Brown.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-183520. Price codes: A03 in paper copy, A01 in microfiche. January 30, 1987. 26p, 1 fig, 3 tab, 19 ref, 8 append.

Descriptors: *Dam effects, *Birds, *Ecology, *Colorado River, *Population density, *Arizona, *Grand Canyon, Withdrawal, Flooding, Dams, Water level.

The densities of riparian breeding birds along the Colorado River between Glen Canyon Dam and Diamond Creek were documented in the spring of 1986. These densities were compared to historical information to reveal long-term population trends and to identify rates of recovery from the effects of the 1983 surplus water releases from the dam. Avian density at established study sites differed significantly between 1984 and 1986. The differences were uniform throughout the river corridor, suggesting one or more large-scale, regional influences. Mean avian density in the new-high-water-zone decreased slightly from 1984 to 1986. Bell's Vireo, Yellow Warbler, and Common Yellowthroat populations declined in abundance after 1983 due to habitat damage and nest inundation. Bell's Vireo and Yellow Warbler quickly recovered, exhibiting a recovery cycle of 2-3 years. Common Yellowthroat failed to recover by 1986 due to loss of its preferred marshy habitat. The densities of five indicator species of obligate riparian birds have increased two-fold or more from 1976 to 1986, in spite of the deleterious effects of the 1983 high water event. Obligate riparian birds have been increasing since the completion of Glen Canyon Dam in 1963 and may continue if outflow from the dam does not exceed maximum powerplant releases. (Author's abstract)
W89-03379

INFAUNAL BENTHIC RECOLONIZATION AFTER DREDGING OPERATIONS IN LA CORUNA BAY, NW SPAIN,
Instituto Espanol de Oceanographia, La Coruna (Spain). Centro Costero del La Coruna.
E. Lopez-Jamar, and J. Mejuto.
Cahiers de Biologie Marine CBIMA5, Vol. 29, No. 1, p 37-49, 1988. 7 fig, 2 tab, 8 ref.

Descriptors: *Bivalves, *Polychaetes, *Dredging, *Environmental effects, Population density, Biomass, Temporal distribution, Ecological effects, Spain, Population dynamics.

In the harbor area of la Coruna Bay (NW Spain) there is a muddy sediment infaunal community dominated by the bivalve Thyasira flexuosa and the polychaete Chaetozone, sp., whose densities are very high (15,000-20,000 individuals/sq m). Dredging operations carried out near a recently built dock determined that in this area the original community was reduced to a few species having short life cycles and to newly settled specimens. After the completion of the dredging operations, temporal variation of the affected area was followed during one year, and it is compared with a nearby area unaffected by dredging. Species number, density and biomass increased significantly after the end of the dredging period. On the other hand, similarity between the dredged and the non-dredged areas increased steadily with time. Diversity values increased initially owing to the recruitment of new species, but then decreased because of the great dominance of Thyasira flexuosa. The recovery of the dredged zone is practically attained 6 months after the completion of dredging operations, although biomass takes longer to reach values similar to those of the unaffected area. (Author's abstract)
W89-03475

EFFECTS OF SEA CAGE SALMON FARMING ON SEDIMENT NITRIFICATION AND DISSIMILATORY NITRATE REDUCTIONS,
Cawthron Inst., Nelson (New Zealand).
H. F. Kaspar, G. H. Hall, and A. J. Holland.
Aquaculture AQCLAL, Vol. 70, No. 4, p 333-344, June 1988. 5 tab, 26 ref.

Descriptors: *Salmon, *Aquaculture, *Marine sediments, *Nitrates, *Water pollution sources, *Nitrification, *Denitrification, Ammonia, Organic compounds, Phosphorus, Nitrogen removal, Fish farming, New Zealand, Sedimentation rates.

Within a few month of the establishment of a sea cage salmon farm in the Marlborough Sounds, New Zealand, sediment physical and chemical characteristics reflected the extremely high sedimentation rate immediately underneath the fish cages. In the surface sediment, dry weight was reduced to about one-third, density was halved and the volatile solids content increased about sevenfold compared with nearby sediments. Similarly, the sediment pools of ammonium, organic N and total phosphorus were much higher underneath the cages than at farther removed sites. The total N/P ratios were the same (1.5) in the surface sediment underneath the cages and in the feed but markedly higher in the less affected areas. In situ nitrification and denitrification were not measureable in the

immediate vicinity of the salmon farm. The potentials for nitrification and denitrification gradually increased from virtually nil underneath the fish cages to commonly observed rates about 30 m from the cages. The complete absence of denitrifying enzymes in the salmon farm sediment to a depth of 6 cm explained why nitrate diffusing from the water column into the sediment was not denitrified. Within 10 m of the fish cages the bulk of added N15-nitrate was reduced to N15-ammonium. The results demonstrate that nitrification/denitrification in the immediate vicinity of a sea cage fish farm is not a significant mechanism of N removal. (Author's abstract)
W89-03477

ENVIRONMENTAL EFFECTS OF THE HIGH DAM AT ASWAN,
Colorado Univ., Boulder. Inst. of Behavioral Science.
G. F. White.
Environment ENTVAR, Vol. 30, No. 7, p 4-11, 34-40, September 1988. 4 fig, 1 tab, 73 ref.

Descriptors: *Flood control, *Reservior storage, *Hydroelectric power, *Dam effects, *Dams, *Water resources development, *Environmental effects, Channel erosion, Water quality, Navigation, Water supply, Water management.

The Aswan High Dam, located in the vicinity of the Nile River's first cataract at Aswan, Egypt, was completed in 1967 and has had as its purposes the following three basic functions: to control all floods of the Nile by their detention in the reservoir; to store water from each annual flood so that there would be regulated releases for irrigation and other purposes throughout the year and over a period of up to 100 years, regardless of low flows upstream; and to use the released water to generate hydroelectric power. The net consequence of the dam's regulation of streamflow has been approximately as expected in 1968; although several earlier studies had anticipated severe channel erosion by the clear waters, the recorded annual bed degradation during the first 12 years after closure amounted to only 2.2, 3.0, 2.5 and 0.40 cm/yr in 4 reaches where measurements were taken. Changes in water quality in the Nile downstream from Aswan can be described principally under four major parameters: (1) a drop in turbidity; (2) an increase of dissolved solids; (3) a mounting salt burden; and (4) an increase in phytoplankton density. Navigation downstream from the dam benefited from the elimination of low flows in some canals and of the swift currents and high levels during the flood season. When the dam was initiated it was anticipated that the powereplant might reach total production by 1980; however, all Aswan power was not sold until 1986. There were believed to be at least 4 reasons for a small net decline in irrigated land despite the goal to increase it: (1) previously-irrigated land was consumed by the construction of new industrial, commercial, and residential structures; (2) the amount of land in old areas declined slightly because of waterlogging, salinity, and alkalinization; (3) brickmaking claimed more than 120 square kilometers of soil annually; and (4) a substantial part of the newly-irrigated land was not cultivated because of unsuccessful practices. (Brock-PTT)
W89-03538

INTEGRATED APPROACH TO HYDROPOWER IMPACT ASSESSMENT. I. ENVIRONMENTAL FEATURES OF SOME NORWEGIAN HYDRO-ELECTRIC LAKES,
Norsk Inst. for Vannforskning, Oslo.
B. Rorslett.
Hydrobiologia HYDRB8, Vol. 164, No. 1, p 39-66, July 8, 1988. 14 fig, 5 tab, 79 ref.

Descriptors: *Dam effects, *Planning, *Environmental impact, *Reservoirs, *Hydroelectric power, *Norway, Water level fluctuations, Erosion, Natural waters, Surveys, Lake classification, Lake morphometry, Storage reservoirs, Optical properties, Thermocline, Research priorities, Benthos.

Concepts relevant to environmental impact-assessment studies on hydropower schemes are described. Norwegian hydroelectric lakes (hydrolakes) and their environmental features are described, and evaluated against non-manipulated waters. A tentative classification of hydrolakes vs natural waters is proposed. The need for a multiple approach to habitat classification is emphasized. Recommendations for future biological impact-assessment approaches are suggested. Hydrolakes differ broadly from natural lakes by combining physical features not ordinarily co-occurring in non-manipulated water bodies. Storage-type hydrolakes (reservoirs) feature winter drawdowns and yearly level fluctuations, whereas other types of hydroelectric lakes have elevated water levels throughout winter. Hydrochemistry and optics of the studied hydrolakes exhibited no clear differences from non-impacted Norwegian inland waters. All lakes had signs of sublacustrine erosional activity related to internal waves and thermocline movements. Future research should carefully evaluate existing hydrological data, or even initiate the necessary hydrological gaging sites whenever feasible. Biologists should adopt fixed-coordinate analysis for all types of benthic communities and they should attempt to develop conceptual, or better, causal models of expected changes following hydropower development, and evaluate the success of these predictions by after-impact studies. (Shidler-PTT)
W89-03586

LAKE TRAVERSE ROPE (RESERVOIR OPERATION PLAN EVALUATION): PROBLEM APPRAISAL REPORT.
Army Engineer District, St. Paul, MN.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 276. Price codes: A06 in paper copy, A01 in microfiche. January 1987. 144p, 14 fig, 7 tab, 8 photos, append.

Descriptors: *Lake Traverse, *Reservoirs, *Ecological effects, *Water resources development, Management planning, Flood control, Water quality, Water supply, Erosion, Orwell Reservoir, North Dakota.

The problem identification information gathered during the initial stages of the St. Paul District, Corps of Engineers Lake Traverse Operation Plan Evaluation is summarized. Significant concerns were gathered through public involvement and in-house experiences with the project. Concerns about flood control, summer low flows on the Bois de Sioux and Red River, water supply, water quality, sedimentation, fish and wildlife, recreation, shoreline erosion, and cultural resources were examined. It is recommended that the Lake Traverse ROPE study be completed as described in the report. The draft ROPE report is scheduled to be completed in September 1987. Lake Traverse and Orwell Reservoir (also a Corps of Engineers reservoir) both affect the Red River of the North downstream of Wahpeton, North Dakota, and Breckenridge, Minnesota. Thus, certain aspects of the recently modified water control plans for Orwell Reservoir are being reviewed to ensure consistency of mutual benefits with the Lake Traverse water control review. (Lantz-PTT)
W89-03745

LAND SUBSIDENCE, EARTH FISSURES, AND WATER-LEVEL CHANGE IN SOUTHERN ARIZONA,
Arizona Bureau of Geology and Mineral Technology, Tucson.
H. H. Schumann, and R. B. Genualdi.
Arizona Bureau of Geology and Mineral Technology Map 23, 1986. 1p, 1 map 19 ref.

Descriptors: *Arizona, *Environmental effects, *Subsidence, *Groundwater level, Groundwater mining, Water resources development.

Land subsidence and earth fissures, which are caused by groundwater depletion, pose geologic hazards in may parts of southern Arizona. Subsidence has affected more than 3,000 sq mi in the State, including parts of Arizona's largest metropolitan areas, Tucson and Phoenix. Differential land subsidence and earth fissures have damaged a variety of engineering structures including buildings, streets, highways, railroads, earthen dams, water wells, water-distribution systems, and wastewater treatment facilities. Earth fissures have also adversely affected urban and agricultural land use. This map provides a general overview of groundwater depletion and resultant land-subsidence and earth fissure problems in the Basin and Range Province of southern Arizona. Although this physiographic province extends north of lat 34 N, the cutoff line used on this map, such phenomena have not been observed north of this latitude, nor do they pose problems in the Transition Zone or Colorado Plateau. (Lantz-PTT)
W89-03761

EFFECTS OF FLOOD CONTROLS PROPOSED FOR THE SUCKER RUN BASIN, CHESTER COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
R. A. Sloto.
Chester County Water Resources Authority Water-Resource Report 1, 1985. 28p, 6 fig, 12 tab, 9 ref.

Descriptors: *Environmental effects, *Flood control, *Pennsylvania, *Simulation analysis, Rainfall-runoff relationships, Hydrologic structure, Flood protection, Sucker Run Basin, Flood peak.

Seven storms in the Sucker Run basin during 1971-78 were simulated with version II of the U.S. Geological Survey distributed routing rainfall-runoff model to evaluate the effectiveness of flood-control designs for reducing peak discharge at nine proposed sites. The effectiveness of a flood control was evaluated by simulating the storms with and without the flood control and comparing the simulating peak discharges. Results of simulations showed that a detention pond proposed for one site would increase the peak discharge of Sucker Run, and that two detention pond designs proposed for another site would have insufficient storage capacity for several of the storms modeled. Construction of two detention ponds on Heffner Run, a tributary, would reduce the 100-year peak discharge of Sucker Run at State Route 82 by 16%. Construction of two detention dams on Sucker Run would reduce the 100-yr peak discharge by 19%. Construction of a retention dam on an unnamed tributary to Sucker Run would reduce the 100-yr peak discharge by 8%. A selected flood-control plan was simulated using the most effective flood controls at three sites and the three detention ponds to be constructed for the expansion of the Chester County Area Airport. The selected flood-control plan would reduce the 100-yr peak discharge of Sucker Run at State Route 82 by 41%. This reduced flood would be equal to a pre-flood control 25-yr peak discharge. (Author's abstract)
W89-03762

WATER RESOURCES INVENTORY OF CONNECTICUT. PART 10: LOWER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-03772

CLADOPHORA GLOMERATA AND ITS DIATOM EPIPHYTES IN THE COLORADO RIVER THROUGH GLEN AND GRAND CANYONS: DISTRIBUTION AND DESSICATION TOLERANCE,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
H. D. Usher, D. W. Blinn, G. G. Hardwick, and W. C. Leibfried.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-183454. Price codes: A04 in paper copy, A01 in microfiche. Final Report, September 1987. 79p, 10 fig, 17 tab, 1 plates, 147 ref. Arizona Game and Fish Dept. Contract 6400042.

Descriptors: *Regulated flow, *Algae, *Colorado River, *Ecological effects, *Water resources de-

velopment, Glen Canyon Dam, Flow, Diatoms, Epiphytes, Population distribution, Ecosystems.

The distribution of Cladophora glomerata, a filamentous green algae, and the associated epiphytes in the Colorado River was examined, and the role of regulated flow and exposure on its distribution and dessication tolerance was determined. The standing crop of Cladophora decreases significantly with distance downstream of Glen Canyon Dam and with increasing depth. The density of epiphytic diatoms on Cladophora decreases significantly with distance downstream of Glen Canyon Dam and with increasing depth. The diatom epiphyte composition changes with distance downstream of Glen Canyon Dam and includes Achnanthes affinis-minutissima, Cocconeis pediculus, Diatoma vulgare, and Rhoicosphenia curvata. Exposure and dessication of Cladophora and its epiphytes result in significant decrease of standing crop and cell density. Twelve hours of exposure can result in significant decrease of standing crop and cell density. One time exposure and repeated cycles of exposure and rewetting both result in significant decrease of standing crop of Cladophora, with repeated cycles of exposure and rewetting showing greater losses. (Author's abstract)
W89-03776

MALARIA CONTROL BY ENGINEERING MEASURES: PRE-WORLD-WAR-II EXAMPLES FROM INDONESIA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 5G.
W89-03794

EFFECT OF POWER PLANT ENTRAINMENT ON THE POPULATION DYNAMICS OF THE BAY ANCHOVY (ANCHOA MITCHILLI),
Martin Marietta Environmental Systems, Columbia, MD.
T. T. Polgar, M. A. Turner, and J. K. Summers.
Ecological Modelling ECMOOT, Vol. 41, No. 3/4, p 201-218, June 1988. 5 fig, 2 tab, 31 ref.

Descriptors: *Environmental impact, *Electric powerplants, *Entrainment, *Fish, *Estuarine environment, *Mortality, Population dynamics, Anchovy, Mathematical models, Ichthyoplankton.

A model of competing sources of mortality is presented for a bay anchovy ichthyoplankton population subject to entrainment losses. Central to the calculation of entrainment impact through modeling is the generation of evolving spatial-temporal distributions for the various life stages from the egg distribution. The model starts with egg distributions over time and space; these eggs develop through time and transported passively by estuarine hydrodynamics. Superimposed on these processes are adjustments for active movement, development into the next age category, mortality due to natural causes, and entrainment mortality at the location of the power plant. The fitting process is iterative and uses variations in the spatial/temporal magnitudes of natural mortality within each stage and in the active movement rates to obtain the best fit with observed distributions. In the best fit of the model-generated distributions with observed data, fractional entrainment loss of 76% is estimated for ichthyoplankton that would have reached the juvenile stage without plant-related mortality. Sensitivity analyses that gauge a reasonable range for this estimate from uncertainties in the distribution data, in larval avoidance, and in cooling system mortality bracket the probable loss at 24-76%. However, results from most of the sensitivity runs indicate that more than 50% of the anchovies are lost by the beginning of the juvenile stage. (Author's abstract)
W89-03823

CHALLENGE OF A VITAL RESOURCE ALONG THE ATCHAFALAYA,
Corps of Engineers, Washington, DC.
M. Reuss.
Environment ENTVAR, Vol. 30, No. 4, p 6-11, 36-44, May 1988.

Descriptors: *Atchafalaya basin, *Louisiana, *Water management, *Decision making, *Political constraints, *Social aspects, *Environmental policy, Recreation, Resources management, Public policy, Protection, Environmental protection, Conservation, Wildlife conservation, Flood protection, Flood control, Land management, Administrative decisions, Fishing, Navigation, Agriculture.

The history of environmental policy decision making with respect to the Atchafalaya basin in southern Louisiana is reviewed. The Atchafalaya River is a 135-mile-long natural distributary of the Mississippi River that empties into the Gulf of Mexico and is the center of one of the most hydrologically dynamic areas in the world. The U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and other agencies have had to balance the needs of flood control, navigation, fish and wildlife conservation, endangered species, recreation, and the preservation of timberland, farm fields, and mining and mineral rights. Dealing with the resulting controversies forced the Corps of Engineers to rely increasingly on administrative skills as well as engineering capabilities. It is concluded that any solution to the Atchafalaya basin issue will require consensus building. The most enduring environmental plan will involve the good faith of all interests, public and private, and all levels of government. (Doria-PTT)
W89-03990

COMPARATIVE STUDY OF THE FISH COMMUNITIES OF TWO NIGERIAN HEADWATER STREAMS IN RELATION TO MAN-MADE PERTURBATIONS,
Cross River State Univ., Uyo (Nigeria). Dept. of Zoology and Fisheries.
For primary bibliographic entry see Field 4C.
W89-03992

STUDY OF VIBRIO ANGUILLARUM STRAINS FROM DIFFERENT SOURCES WITH EMPHASIS ON ECOLOGICAL AND PATHOBIOLOGICAL PROPERTIES,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
J. L. Larsen, H. B. Rasmussen, and I. Dalsgaard.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2264-2267, September 1988. 4 tab, 28 ref. Danish Agricultural and Veterinary Research Council Grant 13-3662.

Descriptors: *Anadromous fish, *Ecological effects, *Vibrio, *Fishases, *Aquaculture, *Epidemiology, *Pathogenic bacteria, Bacteria,ology, Animal pathology, Diseases, Trout, Sediments, Blood, Mortality,ue analysis.

Salmonids that are transferred from fresh water to salt water become exposed to another microbial flora and may become infected with Vibrio anguillarum. The origin of pathogenic V. anguillarum strains and the site(s) at the host where penetration takes place still need clarification. A total of 317 Vibrio anguillarum strains were isolated from water, sediment, and diseased as well as healthy rainbow trout at a Danish mariculture farm and from feral fish caught close to the farm. All strains were examined serologically. Serogroup 01 and to some extent 02 appeared to be associated with trout. Strains from these serogroups were selected for analyses of hemagglutinating activity and surface hydrophobicity. Serogroup 01 comprised hemagglutinating as well as nonhemagglutinating strains; from cases of vibriosis, all 01 strains were nonhemagglutinating. The strains belonging to serogroup 02 were generally hemagglutinating. Examinations of surface hydrophobicity by salt aggregation and hydrophobic interaction chromatography suggested that the 01 strains were more hydrophobic than the 02 strains. In pathogenicity tests, 01 strains isolated from gills and mucus of healthy rainbow trout killed all trout in the test groups. A strain from the intestinal contents of healthy rainbow trout did not product significant mortality. This strain could, however, be frequently reisolated from the pronephros of fish in the test group concerned. After challenge with strains from eel mucus and seawater, mortality was not produced, and furthermore, these strains could not be reisolated from the pronephros. (Author's abstract)
W89-04006

PROGRESS REPORT ON THE GROUNDWATER, SURFACE WATER, AND QUALITY-OF-WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA-1987-88,
Geological Survey, Flagstaff, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04029

PROPOSED WORK PLAN FOR THE STUDY OF HYDROLOGIC IMPACTS OF GROUNDWATER DEVELOPMENT IN THE WET MOUNTAIN VALLEY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04162

ENVIRONMENTAL PROTECTION IN HYDROTECHNICAL AMELIORATION WORKS,
V. S. Altunin, B. K. Rassolov, and S. A. Sokilov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 571-575, April 1988. 3 fig, 1 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 7-10, October 1987.

Descriptors: *Environmental protection, *Water resources development, *Water reuse, Multiobjective planning, Conservation, Technology, Irrigation practices.

The irrational use of nature, particularly when creating and operating large land-improvement systems, leads to a quantitative depletion of natural resources (water, land, etc.) and to a qualitative change (degradation) related to disturbance of the ecologic balance or homeostasis of the ecosystems. A fundamentally new comprehensive 'ecologic-production' approach is needed which would be aimed at all-around nature conservation and optimization of the 'cost/end result' system on the basis of a radical improvement of hydrotechnical improvement systems and technologies with consideration of local natural, economic, and social conditions, the human factor, and time. One of the main directions of such a comprehensive approach is the conversion to a low-waste technology in development and agriculture by introducing economically-effective methods and technical means based on nature-conservation and resources-saving principles. Examples of such methods and means are the improvement of irrigation technology; automation of water accounting and drainage and irrigation planning; secondary use, collection, and drainage of stored waters that seep through the bed of canals and reservoirs; reuse of collector-drain return waters; and utilization and multipurpose use of brines obtained as a result of desalination of mineralized waters. (Shidler-PTT)
W89-04218

EFFECT OF HYDROTECHNICAL CONSTRUCTION ON THE SOIL-COVER COMPLEX OF RIPARIAN TERRITORIES AND NATURE CONSERVATION MEASURES,
N. M. Chamova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 576-580, April 1988. 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 13-15, October 1987.

Descriptors: *Environmental effects, *Water resources development, *Regional planning, *Soil environment, *Riparian land, *Conservation, Flooding, Waterlogging, Regulated flow, Water management, Flood plains, Deltas.

In streams whose flow is regulated, the greatest damage to the soil-cover ecosystem complex is inflicted by flooding, leading to the death of existing vegetation. Waterlogging may be caused by a rise of the groundwater level up to the root zone

during filling of the reservoir or by a change in the flood-plain flooding regime downstream from hydro developments. The zone influenced by the altered hydrological regime below hydropower plants with seasonal and carryover flow regulation extends several hundreds of kilometers downstream, often encompassing the river delta. With daily regulation it extends 80-100 km; with weekly regulation somewhat farther. When developing nature-conservation measures in flood plains and deltas below hydro developments it is necessary to compare the cost and benefit obtained on the lands being irrigated with the losses on the lands drying up so as not to cause a decline in flood-plain productivity due to conflicting works in adjacent regions. To preserve the natural ecosystems of flood plains and deltas it is imperative to isolate, using hydraulic and reclamation structures, stretches which preserve, as far as possible, near-natural conditions. For optimizing release regulation and for verifying water-management measures which provide maintenance of flood-plain meadows as forage, it is necessary to institute ecological monitoring in flood plains and deltas of rivers whose flow is regulated. (Shidler-PTT)
W89-04219

CONSIDERATION OF CHANGES IN THE LOCAL CLIMATE IN THE REGION OF THE RESERVOIR AND LOWER POOL OF HYDROELECTRIC STATIONS,
V. I. Rastorguev, and I. M. Roshchina.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 580-583, April 1988. 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 16-17, October 1987.

Descriptors: *Environmental effects, *Dam effects, *Water resources development, *Climates, *Reservoirs, *Rivers, Electric power production, Hydroelectric power, Orography, Weather, Ice cover, Recreation facilities, Multiobjective planning.

The effect of hydroelectric reservoirs on local climate is due to the increased water volume having a greater heat capacity and to an increase in water surface area, compared with the undammed river. The character and extent of climatic changes depend on the geographic location of the reservoir, orographic conditions, reservoir morphometry, season, time of day, weather conditions (cloudy weather greatly reduces water/land contrast), reservoir operating policy, and regional characteristics such as degree of residential, industrial, or agricultural development. When evaluating the effect of a reservoir on local climatic changes it especially necessary to take into account the influence of the winter polynya (unfrozen stretch of river) which forms annually below a hydro development. The specific characteristics of processes in the area below the dam (the 'lower pool') are determined by the moisture regime. Reservoirs with favorable climatic conditions can provide sites for health-spa complexes, rest homes, resorts, campgrounds, water sports, other sports, beaches, and hunting and fishing areas. Given the current level of technology, it is necessary to increase the intensity of study of reservoirs as objects with a complex structure of natural and economic relations and, consequently, to increase the level of predictions and verification of measures aimed at preventing or lessening negative consequences. (Shidler-PTT)
W89-04220

BIOMEDICAL PROBLEMS OF HYDROTECHNICAL CONSTRUCTION,
A. B. Avakyan, L. I. Elpiner, and W. M. Delitsyn.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 586-590, April 1988. 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 19-21, October 1987.

Descriptors: *Water resources development, *Public health, *Water quality, Aquatic environment, Reservoirs, Pathogens, Parasites, Design criteria, Project planning.

Hydrotechnical and water-management construction impacts on the living conditions and state of health of the population. Changes in hydrological conditions caused by such construction affect the self-purifying capacity (primarily with respect to pathogenic microorganisms) of aquatic ecosystems. Changes in runoff volume can result in either increased or decreased dilution of pollutant discharge, affecting water quality at downstream water-supply intakes. Hydrotechnical water-resource management can affect parasitological conditions by (a) changing stream current velocities, (b) formation of warmed shoals, (c) land waterlogging or draining, (d) producing sediment or chemical loads, (e) creating large water masses (reservoirs), (f) mixing waters of differing hydrobiological characteristics, and (g) as a consequence of changing the surrounding economic (primarily agricultural) activity. The experience gained in recent years by the Institute of Water Problems, Academy of Sciences of the USSR, and the main institutes of the health-care system indicates the need for examining public-health ('biomedical') problems in design practice of hydrotechnical construction. Predictive public-health sections must be included in hydrotechnical project plans and appropriate measures for preventing the negative, and intensifying the positive, consequences of project realization must be taken. (Shidler-PTT)
W89-04222

NATURAL STREAMS AND WATER RESERVOIRS ON THE GOLAN HEIGHTS: CAN THEY CO-EXIST,
For primary bibliographic entry see Field 8A.
W89-04436

7. RESOURCES DATA

7A. Network Design

ESTIMATING RELEASES AND WASTE TREATMENT EFFICIENCIES FOR THE TOXIC CHEMICAL RELEASE INVENTORY FORM,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5B.
W89-03338

INSTALLATION RESTORATION PROGRAM. PHASE II - CONFIRMATION/QUANTIFICATION STAGE 2.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 5G.
W89-03372

IMPROVED ESTIMATES OF GROUNDWATER-MINING ACREAGE,
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 2F.
W89-03420

INTERACTION BETWEEN WATER QUALITY, ENVIRONMENTAL LEGISLATION, AND ECONOMICS IN A HYPOTHETICAL RIVER BASIN,
Environmental Protection Agency, Seattle, WA. Region X.
For primary bibliographic entry see Field 6A.
W89-03698

OPTIMIZATION MODELS IN WATER QUALITY CONTROL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 6A.
W89-03699

AUTOMATIC WATER QUALITY MONITORING IN THE RIVER THAMES CATCHMENT-PRACTICAL ASPECTS OF SYSTEMS DESIGN AND UTILISATION,
Thames Water Authority, Reading (England).
I. M. Griffiths.
IN: Systems Analysis in Water Quality Management. Pergamon Press, New York. 1987. p 369-375, 5 fig, 3 ref.

Descriptors: *System analysis, *Monitoring, *Telemetry, *Catchment areas, *Water quality, *River Thames, *Systems engineering, Water quality management, Rivers, Engineering, Automation, Sampling, Satellite technology, Data transmission, Data processing.

The Thames Water Authority has developed a network of automatic river water quality monitoring stations controlled by a regional telemetry system. The operation of the stations is discussed, and the approaches taken to overcome the problems of freshwater monitoring are highlighted. Intermittent but regular sampling and remote fault monitoring are features of the freshwater system. Satellite data transmission is utilized by mobile stations. Data presentation methods are described including graphical formats for management, archive and real time usage. The role of automatic monitors in the management of river quality is considered and examples are given from within the River Thames catchment. The system is cited as a multidisciplinary approach to water quality management and future developments of the system are discussed. (See also W89-03679) (Author's abstract)
W89-03717

GENERALIZED RADIAL FLOW MODEL FOR HYDRAULIC TESTS IN FRACTURED ROCK,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 7B.
W89-03816

MODELING GROUND WATER QUALITY SAMPLING DECISIONS,
National Taiwan Univ., Taipei. Dept. of Environmental Science.
Y. W. Hsueh, and R. Rajagopal.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 121-134, 4 fig, 6 tab, 35 ref. EPA Cooperative Assistance Agreement No. CR8135522-01-0.

Descriptors: *Sampling, *Groundwater pollution, *Networks, *Network design, Water quality management, Models, Project planning, Public health, Iowa, Test wells, Monitoring, Optimization, Hydrologic data collections.

A strategy for a groundwater quality monitoring program was formulated as an integer programming model (an optimization model). The maximization objective in the model was defined as a weighted function of population exposure to a scaled measure of observed chemical concentrations. The sampling constraints were based on the observed variability of contaminants in the aquifer, needed precision in estimates, a chosen level of significance, the available budget for implementing the program, and selected regulatory constraints. Two versions of the model were tested with field data obtained for 10 selected constituents from the more than 650 wells in the Cambrian-Ordovician aquifer in Iowa. The solutions obtained from both models appear intuitively reasonable and justifiable. The difference between them is mainly due to aggregation effects. The individual well model is tedious, time consuming, and elaborately enumerates the historical statistical distribution of constituents found in individual wells, whereas, in the clustered model such distributions are aggregated by blocks (cells or clusters). However, for regional analysis, clustered models will be cost-effective, whereas, for site-specific analysis, an individual well model must provide the much-needed precision. (Geiger-PTT)
W89-03928

STATISTICAL ISSUES AND PROBLEMS IN GROUND WATER DETECTION MONITORING AT HAZARDOUS WASTE FACILITIES,
Toledo Univ., OH. Dept. of Industrial Engineering.
R. J. McNichols, and C. B. Davis.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 135-150, Fall 1988. 2 fig, 24 ref.

Group 7A—Network Design

Descriptors: *Groundwater pollution, *Hazardous wastes, *Monitoring, *Network design, *Statistical analysis, Sampling, Hydrologic data collection, Water quality management, Statistical methods, Sensitivity analysis.

Groundwater monitoring presents interesting statistical challenges, including controlling the risk of entering compliance monitoring, incorporating all modes of inherent variability into the statistical model on which tests are based, and taming the detection limit problem, all while maintaining demonstrable sensitivity to real contamination. Some of these challenges exceed textbook statistics considerably, even when considered alone, and good solutions are scarce. When these challenges are combined, the task of developing good statistical procedures or good regulations can be formidable. A number of realities of groundwater monitoring are presented that should be considered when developing statistical procedures. Recommendations made for addressing these realities include the following: (1) the false positive rate should be controlled on a facility-wide basis, rather than per well or per parameter as required in the proposed regulation (40 CFR section 264); (2) multiple comparisons with control procedures are preferable to analysis of variance (ANOVA) for controlling the overall false positive rate; (3) retests can be made an explicit part of the statistical procedure in order to increase power and decrease sensitivity to distribution shape assumptions; (4) commonly used simple methods of handling below detection limit data with parametric tests, including Cohen's procedure as implemented in the U.S. EPA's Technical Enforcement Guidance Document (TEGD), should probably be avoided; (5) the statistical properties of practical quantitation limits for nonnaturally occurring compounds should be studied carefully; and (6) so long as the facility-wide false positive rate is controlled, better sensitivity to real contamination is obtained by monitoring fewer well-chosen parameters at a smaller number of well-chosen locations. An evaluation of the proposed revised section 264 regulation with respect to these realities reveals that it seems to be a definite improvement over the current regulation, but that it may be quite difficult to develop an adequate statistical plan within its constraints. (Author's abstract)
W89-03929

PILOT STUDY FOR COLLECTION OF BRIDGE-SCOUR DATA,
Geological Survey, Lakewood, CO. Water Resources Div.
R. D. Jarrett, and J. M. Boyle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4030, 1986. 46p, 9 fig, 33 ref.

Descriptors: *Scour, *Bridge scour, *Data collections, Piers, Instruments, Local scour, Channel erosion, Colorado.

Scour around bridges is a serious problem on many rivers; bridge failure often is attributed to undermining of piers or abutments by scour. A pilot study was made at four bridge sites in Colorado to develop and test guidelines for collecting scour data onsite during high flows. These guidelines potentially could be used to conduct bridge-scour studies or to establish a nationwide bridge-scour data collection program in conjunction with normal high-flow measurements. The methods tested are intended to be compatible with equipment and procedures commonly used in the U.S. Geological Survey streamflow-gaging program. Thirteen scour-prediction equations were evaluated using data collected during this study. Two alternative approaches for future, proposed scour studies are indicated. The type of approach selected would depend on the objectives of the scour study and the flow conditions in the study area. (USGS)
W89-04062

METEOROLOGICAL, WATER TEMPERATURE, AND DISCHARGE DATA FOR THE MATTOLE RIVER BASIN, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. D. Noble, and A. P. Jackman.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 78-81, 1983. 32p, 6 fig, 7 tab, 11 ref.

Descriptors: *Meteorological data, *Water temperature, *Synoptic data collections, *Data collections, *Mathematical modeling, Wind velocity, Air temperature, Radiation.

To overcome a major difficulty in the testing of the validity of river-temperature models - the lack of adequate precise synoptic data for an entire river basin - synoptic meteorologic, water-temperature, and discharge data were obtained in the Mattole River Basin in northern California during the period June 10 through August 31, 1975. The variables monitored were water temperature in the main channel and major tributaries, wind velocity, wet-bulb and dry-bulb air temperature, total hemispherical incoming radiation, total incoming shortwave radiation, discharge in the main channel and major tributaries, and average velocity and axial dispersion coefficients in the main channel. This report describes the experimental design and the instrumentation and procedures followed to insure the best possible information, and it presents a detailed set of data which can be used in testing river-temperature models. (USGS)
W89-04084

GEOHYDROLOGY AND GROUNDWATER QUALITY MONITORING NETWORK FOR THE ANTELOPE VALLEY AREA, CALIFORNIA,
Geological Survey, Tahoe City, CA. Water Resources Div.
L. F. W. Duell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 84-4081, 1987. 72p, 11 fig, 3 pl, 30 ref.

Descriptors: *Network design, *Geohydrology, *Monitoring, *Water quality, *California, Land use, Groundwater recharge, Wastewater disposal, Water pollution sources, Antelope Valley.

A basinwide ideal network and an actual network were designed to identify ambient groundwater quality, trends in groundwater quality, and degree of threat from potential pollution sources in Antelope Valley, California. In general, throughout the valley groundwater quality has remained unchanged, and no specific trends are apparent. The main source of groundwater for the valley is generally suitable for domestic, irrigation, and most industrial uses. Water quality data for selected constituents of some network wells and surface-water sites are presented. The ideal network of 77 sites was selected on the basis of site-specific criteria, geohydrology, and current land use (agricultural, residential, and industrial). These sites were used as a guide in the design of the actual network consisting of 44 existing wells. Wells are currently being monitored and were selected whenever possible because of budgetary constraints. Of the remaining ideal sites, 20 have existing wells not part of a current water quality network, and 13 are locations where no wells exist. The methodology used for the selection of sites, constituents monitored, and frequency of analysis will enable network users to make appropriate future changes to the monitoring network. (USGS)
W89-04114

WATER RESOURCES INVESTIGATIONS IN TENNESSEE: PROGRAMS AND ACTIVITIES OF THE U. S. GEOLOGICAL SURVEY, 1986-87,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04139

REVIEW OF THE WATER RESOURCES INFORMATION SYSTEM OF ARGENTINA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04142

WATER USE DATA COLLECTION PROGRAMS AND REGIONAL DATA BASE OF THE GREAT LAKES-ST. LAWRENCE RIVER BASIN STATES AND PROVINCES,
Geological Survey, Albany, NY. Water Resources Div.
D. S. Snavely.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-546, 1986. 204p, 7 fig, 8 tab, 60 ref.

Descriptors: *Water use, *Data collections, *Water supply, *Great Lakes, Consumptive use, Diversion, Withdrawal, Return water, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania, Quebec, Wisconsin, St. Lawrence River basin.

As a result of the Great Lakes Charter (signed by Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania, Quebec, and Wisconsin), the Geological Survey worked with a committee of the Council of Great Lakes Governors to document the water use data collection programs in the Basin. These programs are described for public water supply; supplies for domestic, irrigation, agricultural, commercial, industrial, and mining uses; and supplies for powerplants. Frequency of collection, trigger levels, storage methods, and legislative framework are described. A regional water use data base was designed to store withdrawal, diversion, and consumptive use data on a drainage basin basis. The data base will be used to decide the advisability of proposed water diversion and consumptive use projects as part of a water management strategy. Data base formats, requirements, and methods of data transmittal from each area are described. Methods for acquiring missing data are suggested. The data base will be housed by the Great Lakes Commission, Ann Arbor, Michigan. (USGS)
W89-04154

PREDICTING ACIDIFICATION EFFECTS ON FISH POPULATIONS, USING LABORATORY DATA AND FIELD INFORMATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-04339

7B. Data Acquisition

ESTIMATING RELEASES AND WASTE TREATMENT EFFICIENCIES FOR THE TOXIC CHEMICAL RELEASE INVENTORY FORM,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5B.
W89-03338

TECHNIQUES FOR MEASURING RESERVOIR BANK EROSION,
Cold Regions Research and Engineering Lab., Hanover, NH.
L. W. Gatto.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 400. Price codes: A03 in paper copy, A01 in microfiche. Special Report 88-3, February 1988. 27p, 8 fig, 1 tab, 61 ref.

Descriptors: *Reservoirs, *Bank erosion, Erosion, Bank stabilization, Slope stability, Photography, Data acquisition.

A number of studies have addressed bank erosion along the shores of reservoirs, lakes, rivers and coasts. Bank erosion occurs in all climates throughout the year. Consequently, year-round data collection is required to do a thorough study of erosion processes in any location. The amounts of erosion and resultant recession at a given bank

vary temporally and spatially. Because of this site-specific variability and because several studies have shown that erosion and recession are usually episodic, field measurements and observations repeated over a number of years are required to get true values for bank erosion and recession rates and to evaluate the processes and conditions responsible for causing the bank erosion. This report has highlighted some of the methods that have been used to measure these rates and do the evaluations (leveling, rod measurements, stereo photographs, slope measurements, and electronic distance measurement). Project requirements and site characteristics will determine the methods appropriate for a particular site. Erosion pins and profiles are most frequently used to measure bank face changes and reference stakes are typically used to document changes in bank crest positions. Whichever methods are used, however, photographs should be taken to document conditions during every site visit. (Lantz-PTT)
W89-03343

DESCRIPTION OF LANDSCAPE SEDIMENT MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-03353

STRATEGIES AND DIFFICULTIES OF APPLYING MODELS TO AQUATIC POPULATIONS AND FOOD WEBS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. L. DeAngelis.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-002804. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-870835--1, (1987). 29p, 3 fig, 35 ref. DOE Contract DE-AC05-84OR21400, and NSF Grant BSR-80-21024.

Descriptors: *Limnology, *Model studies, *Aquatic populations, *Fisheries, *Food chain, Mathematical models, Ecosystems, Case studies, Ecology.

This report describes problems that occur during the development of mathematical models and that can be tested with a hypothesis. The relationships between increased levels of atmospheric carbon dioxide and declining fisheries stocks were selected as the primary example. Other examples are more briefly discussed. The current scope of biological modeling and the direction that current research appears to be taking is reviewed. (Lantz-PTT)
W89-03355

CONTRASTING HYDROLOGIC PROCESSES ON SEMIARID AND HUMID WATERSHEDS,
Washington Univ., Seattle.
For primary bibliographic entry see Field 2A.
W89-03359

INTERACTIVE SIMULATION OF THE FATE OF HAZARDOUS CHEMICALS DURING LAND TREATMENT OF OILY WASTES: RITZ USER'S GUIDE.
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5D.
W89-03362

NEW YORK HARBOR WATER QUALITY SURVEY, 1986.
New York City Dept. of Environmental Protection, Wards Island. Water Quality Section.
For primary bibliographic entry see Field 5B.
W89-03373

HIGH-RESOLUTION SAMPLER OF SURFACE PEAT,
Queen Mary Coll., London (England). School of Biological Sciences.
R. S. Clymo.
Functional Ecology, Vol. 2, No. 3, p 425-431, 1988. 5 fig, 17 ref.

Descriptors: *Wetlands, *Data acquisition, *Peat, *Sampling, Cores, Sample preparation, Sample preservation, Fugitive water.

The sampler extracts uncompressed cores of 20-cm diameter, 50-70 cm long from the surface layers of peat. Peat water remains undisturbed in the cores and fugitive variables are also retained. Slices as thin as 1 cm can be made with ease. Cores can be got from pools and hollows as well as from lawns and hummocks. (Author's abstract)
W89-03392

MEASURING GROUND WATER LEVELS IN WELLS,
Springfield City Utilities, MO.
R. Rogers, and L. Scheuch.
Water Well Journal WWJOA9, Vol. 42, No. 10, p 25-27, October 1988. 1 fig, 4 ref.

Descriptors: *Water level, *Data acquisition, *Groundwater level, *Measuring instruments, Well data, Pumping tests, Acoustics, Comparison studies, Data interpretation, Well casings, Wells.

The most common methods of measuring water levels in wells include direct measurement with an electric tape line or indirect measurement through the use of an air line. Changes in the groundwater system can occur quickly; therefore data needs to be obtained quickly. The ability to take efficient measurements is even more important in doing pumping tests. Acoustic equipment provides this ability. As demonstrated by a comparison with conventional methods, time savings were significant; on the average it took approximately five minutes to obtain a water-level reading using the acoustic equipment. Conventional methods took anywhere from 15 minutes to an hour. Acoustic equipment also accurately measured well-water level compared with conventional methods. The manufacturer claims accuracy of plus or minus 10 feet, but the authors estimated the accuracy to be closer to plus or minus 5 feet. The resulting data was simple to interpret and easy to reduce; no special knowledge or skills were required. The acoustic liquid-level instrument overcame the tangling, spurious-reading, and electrode-loss problems that are encountered in using an electric tape line or an air line. It is invaluable for use on large wells where pumping equipment prevents direct access to the well annulus. The data obtained can help in determining pumping rates, siting new wells, and forecasting future groundwater supply vs needs. (Shidler-PTT)
W89-03394

210PB DATING OF LAKE SEDIMENTS AND OMBROTROPHIC PEATS BY GAMMA ASSAY,
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
P. G. Appleby, P. J. Nolan, F. Oldfield, N. Richardson, and S. R. Higgitt.
Science of the Total Environment STENDL, Vol. 69, p 157-177, 1988. 11 fig, 9 ref.

Descriptors: *Lake sediments, *Peat, *Radioactive dating, *Gamma radiation, *Lead radioisotopes, Radium radioisotopes, Cesium radioisotopes, Absorption.

Measurements were made using low-background well-type and planar Germanium detectors. The associated radium-226 concentrations were measured by gamma emissions from lead 214 at 352 keV. A comparison of cesium-137 emissions at 32 keV and 662 keV, and lead-210 and lead-214 emissions for samples in radioactive equilibrium, indicated that self-absorption in lake-sediment samples did appear to be significant at lower energy levels. Attenuation factors to correct for this were determined. The analysis of peat samples was facilitated by ashing the material at 450 C prior to measurement. Results from a number of sites are presented. (Author's abstract)
W89-03398

COMBINED MEMBRANE FILTER-IMMUNOFLUORESCENT TECHNIQUE FOR THE IN SITU IDENTIFICATION AND ENUMERATION OF ACINETOBACTER IN ACTIVATED SLUDGE,
Pretoria Univ. (South Africa). Dept. of Microbiology and Plant Pathology.
For primary bibliographic entry see Field 5D.
W89-03432

THEORY OF FLUORESCENT IRRADIANCE FIELDS IN NATURAL WATERS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2K.
W89-03478

CORRELATIONS BETWEEN PHYSICO-CHEMICAL FACTORS AND POPULATION DENSITY OF CLADOCERANS IN THE TIGRIS AND DIYALA RIVERS AT BAGHDAD, IRAQ,
Scientific Research Council, Baghdad (Iraq).
For primary bibliographic entry see Field 2E.
W89-03487

INEXPENSIVE DEVICE FOR SAMPLING LARGE VOLUMES OF LAKE WATER FROM DISCRETE DEPTHS,
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds, and J. C. Priscu.
Freshwater Biology FWBLAB, Vol. 20, No. 1, p 113-115, August 1988. 1 fig, 1 tab.

Descriptors: *Water sampling, *Sampling, *Water sampling, *Lakes, *Phytoplankton, Photosynthesis.

A sampler was developed that displaces surface water which is replaced with water from a sampling tube at a set depth. The displacement sampler is inexpensive, easy to build, and is capable of collecting water at 7.5 L/min. Phytoplankton photosynthesis was higher in water from the displacement sampler than in water collected with a Van-Dorn bottle. Subsequent experiments indicated this was due to inhibition caused by the Van-Dorn bottle. (Author's abstract)
W89-03501

TRACE ORGANIC COMPOUNDS IN GROUND WATER IN SOUTH-CENTRAL KANSAS AS INFERRED FROM GAS CHROMATOGRAPHY WITH FLAME-IONIZATION DETECTION,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W89-03597

ANALYTICAL PROCEDURES FOR THE DETERMINATION OF DISPERSE AZO DYES,
Environmental Protection Agency, Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W89-03615

SOLUBILITY OF DISPERSE DYES -- ENVIRONMENTAL IMPLICATIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5A.
W89-03619

ION EXCHANGE-SPECTROPHOTOMETRIC DETERMINATION OF PPB AND SUB-PPB CD,
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
For primary bibliographic entry see Field 5A.
W89-03653

PHYSICAL AND CHEMICAL METHODS FOR THE CHARACTERIZATION OF HAZARDOUS WASTES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5A.
W89-03731

EVALUATION OF TECHNIQUES FOR MEASURING STREAMFLOW AND FOR ESTIMATING FLOW CHARACTERISTICS OF STREAMS IN THE MISSISSIPPI RIVER DELTA, PRAIRIES, AND COASTAL MARSHES OF LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
F. N. Lee, and R. K. White.
Louisiana Department of Transportation and Development Water Resources Technical Report No. 40, 1987. 72p, 8 fig, 9 tab, 2 plates, 7 ref.

Descriptors: *Flow measurements, *Streamflow, *Flow profiles, *Mississippi River, *Coastal waters, *Measuring instruments, *Data acquisition, *Louisiana, Discharge measurement, Tidal currents, Flow velocity, Statistical analysis.

Although conventional methods of computing discharge on a continuous basis are not completely applicable for streams in the prairies and coastal marshes of Louisiana, a recently developed method which uses the bidirectional electromagnetic flowmeter system was successful in measuring discharges at four sites in these areas. Comparison of discharge computed using electromagnetic flowmeter data and discharge computed using stage-fall-discharge computations for Vermilion River at Lafayette, Louisiana, shows that the two methods produced comparable results. The resulting regression of the two sets of data gave R-squared values of 0.96 and 0.92 for instantaneous discharge measurements and computed daily mean discharge measurements, respectively. For the period monitored, total runoff computed using the electromagnetic flowmeter data was about 7% greater than the total runoff computed using the stage-fall-discharge method. Streams in the Mississippi River Delta, prairies, and coastal marshes have distinct flow characteristics and were grouped into three categories according to their flow-regime: (1) Streams affected by daily tidal fluctuation and headwater flow--Bayou Choupique and Bayou Lacassine; (2) streams affected by rainfall and possibly backwater, and that flow only during excessive rainfall-Bayou Queue de Tortue, Bayou Grosse Tete, and Bayou Chene; and (3) streams that have continuous flow and are affected intermittently by tidal fluctuations--Vermillion River and Amite River. Field inspection and general knowledge of the prairies and coastal marshes show that most streams in the study area are in category 1. A unit-velocity curve developed for category 1 streams, using Bayou Choupique and Bayou Lacassine, shows potential as a method for estimating streamflow variability in the prairies and coastal marshes at sites where no streamflow information is available. Analysis of discharge measurements made in the Mississippi River Delta, prairies, and coastal marshes showed that about 85% of the streams measured were either dry or had no flow, indicating that the 7-day, 2-yr, and 1-yr discharges would equal zero. (Author's abstract)
W89-03757

TWIN LAKE TRACER TESTS: SETTING, METHODOLOGY, AND HYDRAULIC CONDUCTIVITY DISTRIBUTION,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2F.
W89-03799

GENERALIZED RADIAL FLOW MODEL FOR HYDRAULIC TESTS IN FRACTURED ROCK,
British Geological Survey, Wallingford (England).
J. A. Baker.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1796-1804, October 1988. 3 fig, 1 tab, 21 ref, 2 append.

Descriptors: *Aquifer testing, *Pumping tests, *Hydrologic models, *Mathematical models, *Groundwater movement, *Fracture permeability, Geologic fractures, Flow rates, Pressure head.

Models commonly used for the analysis of hydraulic test data are generalized by regarding the dimension of the flow to be a parameter which is not necessarily integral and which must be determined empirically. Mathematical solutions for this generalized radial flow model are derived for the standard test conditions: constant rate, constant head, and slug tests. Solutions given. Well bore storage and skin are included and the extension to dual-porosity media outline. The model is presented as a model of fractured media, for which it is most likely to find application because of the problem of choosing the appropriate flow dimension. (Author's abstract)
W89-03816

COMPARISON OF ACTIVE MICROWAVE SOIL WATER CONTENT WITH INFRARED SURFACE TEMPERATURES AND SURFACE MOISTURE AVAILABILITY,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
E. M. Perry, and T. N. Carlson.
Water Resources Research WRERAO, Vol. 24, No. 10, p 1818-1824, October 1988. 6 fig, 2 tab, 25 ref.

Descriptors: *Remote sensing, *Infrared imagery, *Moisture availability, *Microwaves, *Soil water, *Soil temperature, Mathematical models, France.

Active microwave soil water content and thermal infrared surface temperatures were made simultaneously from an aircraft flying at 400 m over a vegetated region in France. Microwave soil water content was obtained using the French ERASME scatterometer and the surface temperatures with the aid of a PRT-5 radiometer. Correlations between surface temperature or soil moisture availability (determined from model calculations) and microwave soil moisture were made in both the space (within and between fields) and time domains. A standard error in the infrared temperature and soil moisture availability due to influences other than that of soil moisture were estimated with the aid of a model (Carlson, 1986). Where the standard deviation of the temperature or moisture availability is greater than this standard error (which is the equivalent of about plus or minus 2 Celsius), correlations between soil water content and moisture availability become significant and improve with increasing spatial or temporal variance in the measured surface temperatures. When drying is allowed to proceed under strong sunlight for a period of a week or so, the temporal variations in soil moisture become so large that the temporal correlation between surface temperature and soil water content approaches -1.0. Spatial correlations over wet terrain show very poor correlation with measured soil moisture. (Author's abstract)
W89-03818

RELATIVE SELECTIVITY OF FIVE COASTAL MARSH SAMPLING GEARS,
Louisiana Cooperative Fish and Wildlife Research Unit., Baton Rouge.
R. D. Hartman, and W. H. Herke.
Contributions in Marine Science, Vol. 30, p 17-26, December 1987. 4 tab, 16 ref.

Descriptors: *Trawls, *Sampling, *Biological Samples, *Marshes, Fish, Crustaceans, Selectivity, Population density, Species diversity.

Two otter trawls (1.8-m and 4.8-m), two push trawls of differing widths (2.1-m and 4.2-m), and a 57-m long-haul seine were evaluated for sampling fishes and crustaceans in a shallow coastal marsh of southwest Louisiana. Ease of use, number of species captured, and number of organisms per 1000 sq m of surface area sampled were compared for each sampling gear. Although the otter trawls were easiest to use, they yielded the lowest density of organisms for most species. The wide push trawl was the most expensive and cumbersome gear, but yielded the highest number of organisms/1000 sq m. The long-haul seine was the most difficult gear to use, but captured the most species, the most species per sample, and generally the most organisms per sample. (Author's abstract)
W89-03851

PERIPHYTON SAMPLER FOR SHALLOW, SWIFT RIVERS,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
B. J. F. Biggs.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 22, No. 2, p 189-199, 1988. 6 fig, 6 tab, 33 ref.

Descriptors: *Periphyton, *Sampling, *Stream biota, *Monitoring, *Rivers, Biological samples, Substrates, Evaluation, Algae, Diatoms.

A bottom-seated artificial substrate periphyton sampler was designed and evaluated for use in shallow, swift rivers. The sampler was found to be robust, but 19% of samples were lost owing to flooding and 17% because of vandalism. Both glass and perspex are usable as substrates providing the surfaces are well etched. Vertically oriented substrates gave the highest sample precision and are recommended for routine monitoring. Variability within samplers was generally greater than between samplers. Mean within-sampler coefficients of variation were 54% for algal density, 12% for algal diversity, 43% for chlorophyll a, and 36% for ash-free dry weight. The numbers of replicates required to obtain given percentage errors for various determinants are presented as nomographs. One sampler per station enabled most moderate or large changes in the structure of communities to be detected. (Author's abstract)
W89-03864

METHODS OF MEASURING DISINFECTANT RESIDUALS,
Miami Univ., Oxford, OH. Hughes Labs.
For primary bibliographic entry see Field 5F.
W89-03881

USING HEADSPACE SAMPLING WITH CAPILLARY COLUMN GC-MS TO ANALYZE TRACE VOLATILE ORGANICS IN WATER AND WASTEWATER,
Alaska Univ., Anchorage. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-03889

AUTOMATED IN SITU MEASUREMENT OF UNSATURATED SOIL WATER FLUX,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 2G.
W89-03897

COMPARISON OF A LABORATORY PROCEDURE AND A TEXTURAL MODEL FOR PREDICTING IN SITU SOIL WATER RETENTION,
North Dakota State Water Commission, Bismarck. Hydrology Div.
For primary bibliographic entry see Field 2G.
W89-03898

HAZARDOUS WASTE: WHERE TO PUT IT - WHERE WILL IT GO,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W89-03919

NEW CONTINUOUS-SAMPLING WIRELINE SYSTEM FOR ACQUISITION OF UNCONTAMINATED, MINIMALLY DISTURBED SOIL SAMPLES,
R. R. Clark.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 66-72, Fall 1988. 6 fig.

Descriptors: *Core drilling, *Sampling, *Soil samplers, *Drilling equipment, Rotary drilling, Hydrological data collection, Monitoring, Soil contamination.

A new wireline system has been developed to alternately full-hole drill or continuously sample soil in a variety of soils. Those samples recovered by the system are complete, relatively undisturbed,

and minimally affected by drilling fluids. The system, which includes an outer barrel, center-bit insert tube and a spring-retract-sampler inner barrel, can be used with either a core or rotary-type drill. The system's outer barrel and bit act as a casing advancer to prevent hole collapse in unstable soils. The outer barrel and bit remain in the hole while either the center-bit-insert tube or the soil-sampler inner barrel are wirelined in and out of the outer barrel and rill rod column. When the center-bit insert is wirelined into place, it combines with the outer barrel and bit to become a full-hole drilling tool. When this center-bit insert is replaced with the soil-sampler inner barrel, the system is capable of continuous soil sampling to depths ranging from several hundred to several thousand feet. The spring of this soil-sampler inner barrel is designed to extend the drive-shoe some 6 to 8 inches ahead of the outer-barrel bit and the circulating fluids. Therefore, the sample is not in continuous contact with the circulating fluids during the sampling process. As the sample enters the soil-sampler tube, those circulating fluids inside the tube are forced up and out through the inner barrel's fluid bypass. The result is a sample relatively free of contamination or washing by drilling fluids. Because the soil-sampler tube comes in contact with the circulating fluid as it travels into sampling position, there is a film coating the recovered sample. Similarly, the fluid also coats either end of the sample. However, that film is easily scraped away before analysis. Should additional protection be required, a liner can be inserted inside the sampler tube. Sample contaminants can be totally eliminated through the use of filtered-air circulation. In field use, negligible tearing or amalgamation of the samples has been experienced, because the soil-sampler tube and retract-spring are suspended from dual bearings, which prevent inner barrel rotation. (Author's abstract)
W89-03920

GENERALIZED GROUND WATER SAMPLING DEVICE MATRIX,
Nevada Univ. System, Las Vegas. Water Resources Center.
K. F. Pohlmann, and J. W. Hess.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 82-84, Fall 1988. 10 ref. EPA Contract CR-812713-01-5.

Descriptors: *Groundwater data collection, *Samplers, *Sampling, *Hydrologic data collection, *Pumps, Test wells, Monitoring, Hydraulic machinery, Coliforms, Conductivity, Hydrogen ion concentration, Radium radioisotopes, Nitrates, Trace metals, Organic carbon.

A generalized groundwater sampling device matrix was prepared and submitted to the U.S. EPA as part of a cooperative research program. The chart is based on a review of the literature and illustrates general relations of groundwater parameters to sampling devices. The 12 types of sampling devices considered include: open bailer, point-source bailer, syringe sampler, gear-drive pump, bladder pump, helical-rotor pump, gas-drive piston pump, centrifugal pump, peristaltic pump, gas-lift devices, gas-drive devices, and pneumatic devices. The 14 groundwater parameters considered are: electrical conductivity, pH, redox potential, major ions, trace metals, nitrate and fluoride, dissolved gases, non-volatile organics, volatile organics, TOC, TOX, radium, gross alpha and beta activity, and coliform bacteria. Notes regarding sampling depths, well diameters, sample delivery rates, and construction materials are included. The matrix was prepared in response to groundwater sampling research needs expressed by the U.S. EPA Regional and Program Offices and is one part of EMSL-LV's continuing Comparative testing of Ground Water Sampling Methods research project. (Geiger-PTT)
W89-03922

EVALUATION OF A CARBON ADSORPTION METHOD FOR SAMPLING GASOLINE VAPORS IN THE SUBSURFACE,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W89-03923

CHANGES IN VOLATILE ORGANIC CHEMICAL CONCENTRATIONS AFTER PURGING SLOWLY RECOVERING WELLS,
Illinois State Geological Survey Div., Champaign.
B. L. Herzog, S. J. Chou, J. R. Valkenburg, and R. A. Griffin.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 93-99, Fall 1988. 4 fig, 4 tab, 21 ref.

Descriptors: *Groundwater pollution, *Sample preservation, *Organic compounds, *Purging, *Sampling, *Test wells, Hydrologic data collections, Models, Statistical analysis.

Most guidelines for sampling groundwater require the evacuation of multiple bore volumes from the well before a sample is collected. Such recommendations are impractical for wells that are finished in fine-grained deposits with such slow recharge that they cannot recover rapidly enough for the requisite number of well volumes to be removed. In such situations, the sample is usually collected either 24 hours after evacuation or sometime during well recovery. Neither of these strategies has been supported by field evidence. The purpose of this study was to determine the changes in volatile organic chemical concentration during well recovery. Three hundred samples were analyzed for up to 19 different volatile organic compounds from 11 wells that were finished in fine-grained glacial tills. Each well was sampled before purging and at several time intervals up to 48 hours after purging. The experiment was conducted three to five times on each well. Samples were collected with dedicated point-source PTFE bailers equipped with bottom-emptying devices that were designed for collecting samples for volatile organic chemical analysis. All wells were evacuated with a bailer because they were finished in slowly recharging materials having hydraulic conductivities of between .000006 and .00007 cm/sec. Results of the chemical analyses were examined statistically using a general linear model and the Tukey honestly significant difference test to ascertain whether the changes in water quality with time after purging were statistically significant. At the 95% confidence level, there was no significant difference in chemical compositions at any time interval after purging, although samples collected at four hours had slightly higher concentrations than did earlier or later samples. However, concentrations of volatile organics were significantly lower before purging than after purging. These results clearly show that wells finished in fine-grained sediments should be purged before samples are collected for volatile organic chemical analysis. (Author's abstract)
W89-03924

INEXPENSIVE, MULTI-USE, DEDICATED PUMP FOR GROUND WATER MONITORING WELLS,
Gartner Lee Associates Ltd., Markham (Ontario).
E. H. Rannie, and R. L. Nadon.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 100-107, 4 fig, 3 tab, 12 ref.

Descriptors: *Groundwater, *Monitoring, *Sampling, *Pumps, Test wells, Hydraulic machinery, Organic compounds, Permeability coefficient.

A simple, inexpensive sampling pump has lately come into use in groundwater monitoring. The pump is referred to as an inertial pump; its only downhole components are a foot valve connected to a length of tubing or pipe. The operating principle of the pump is based on the inertia of a column of water within the riser tubing. Groundwater is drawn through the foot valve and up the riser tubing by rapid up and down movements of the tubing. This pumping method is not new, but has only recently been applied to monitoring wells. Foot valves are available in a variety of materials and sizes and can be used in monitoring wells as small as 19 mm (3/4 inch) I.D. Flexible polyethylene or Teflon tubing, and in some cases stainless steel tubing or rigid PVC pipe, is used as the riser. The inertial pump satisfies most of the criteria normally cited for an ideal sampling device. The pump is easy to operate, reliable, durable, portable, and virtually maintenance-free. It can be operated manually from as deep as 40 m or from as deep as 60 m using a motor drive. The pump is inexpensive, and therefore suitable for use as a dedicated sampling pump. Recent tests have shown the pump to be suitable for sampling volatile organics. The inertial pump has a high flow capacity and performs well in silty/sandy environments, which makes it useful for developing and purging monitoring wells. It may also be used to perform field hydraulic conductivity tests. (Author's abstract)
W89-03925

EVALUATION OF SOME SYSTEMS FOR SAMPLING GAS-CHARGED GROUND WATER FOR VOLATILE ORGANIC ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, and R. Dickhout.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 4, p 112-120, Fall, 1988. 1 fig, 8 tab, 15 ref.

Descriptors: *Organic compounds, *Pollutant identification, *Monitoring, *Groundwater pollution, *Pumps, *Sampling, Methane, Aromatic compounds, Hydraulic machinery, Volatility, Hydrologic data collections.

Loss of volatile organics during sampling is a well-recognized source of bias in groundwater monitoring; sampling protocols attempt to minimize such loss. Such bias could be enhanced for groundwater highly charged with dissolved gases such as methane. Such groundwater was the object of this study. A positive-displacement bladder pump, a momentum-lift pump and a suction-lift, peristaltic pump were employed in sampling both methane-charged groundwater for volatile aromatic hydrocarbons and a CO2-charged reservoir water for volatile chlorinated hydrocarbons. In both cases, the suction-lift pump produced samples with a significant negative bias (9 to 33%) relative to the other methods. Little difference between samples produced by the other pump systems was noted at the field site, but in sampling the reservoir, the bladder pump produced samples that were 13 to 19% lower in halocarbon concentration than were samples from the momentum-lift pump. These negative biases are tentatively interpreted as losses due to volatilization during sampling. Slightly greater negative biases occur for compounds of higher volatility as estimated from their Henry's law constants. Additional studies appear to be warranted in order to adequately establish the scientific basis for recommending protocols for sampling groundwater in which degassing could enhance the loss of volatile organics during sampling. (Author's abstract)
W89-03927

CHARACTERISATION OF METAL FORMS IN SEWAGE SLUDGE BY CHEMICAL EXTRACTION AND PROGRESSIVE ACIDIFICATION,
Consultants in Environmental Sciences Ltd., London (England).
T. Rudd, D. L. Lake, I. Mehrotra, R. M. Sterritt, and P. W. W. Kirk.
Science of the Total Environment STENDL, Vol. 74, p 149-175, August 1, 1988. 11 fig, 7 tab, 35 ref.

Descriptors: *Heavy metals, *Sludge, *Wastewater, *Chemical analysis, *Pollutant identification, Metals, Cadmium, Copper, Nickel, Lead, Zinc, Hydrogen ion concentration, Speciation, Calcium chloride.

Sequential chemical extraction, acidification to pH 4, 2 and 0.5, and repetitive CaCl2 (0.05 M) extractions were used to evaluate the forms of Cd, Cu, Ni, Pb and Zn in seven sewage sludges. There was more variation in the fractionation profiles of different metals in the same sludge than of the same metal in different sludges. Speciation in air-dried and liquid forms of sludges differed slightly, but the former gave more reproducible results. The sequential extraction scheme indicated that the predominant fractions of Pb and Zn were extractable in 0.1 M Na4P2O7, corresponding to organic and some insoluble inorganic forms. The largest Cd

and Ni fractions were extractable in 0.2 M sodium ethylenediaminetetraacetate (pH 6.5), corresponding to the carbonates. The major forms of Cu were probably the sulfide and organic phases, both extractable in 6 M HNO3. Progressive acidification of liquid sludges mobilized significant quantities of Zn at pH 4, of Cd and Pb at pH 2 and of Ni at all pH values investigated. Copper was relatively immobile throughout. Application of the sequential extraction scheme to the residues obtained following acidification indicates that Cu, Cd and Pb forms were relatively stable, but that Ni and Zn speciation was likely to change with decreasing pH. Repeated CaCl2 extractions resulted in a low degree of metal mobilization and had little effect on the speciation of the metals remaining in the sludge. (Author's abstract)
W89-03962

METHOD FOR EVALUATING MUTAGENICITY OF WATER: I. A NEW METHOD OF PREPARING SAMPLES FOR MUTAGENICITY TEST,
Yokohama National Univ. (Japan).
For primary bibliographic entry see Field 5A.
W89-03963

DIGITISING PLUVIOGRAPHS,
Meteorological Service, Wellington (New Zealand).
J. Sansom.
Journal of Hydrology JHYDA7, Vol. 26, No. 2, p 197-209, 1987. 5 fig, 3 tab, 3 ref.

Descriptors: *Data processing, *Rain gages, *Rainfall rate, Pluviographs, Rainfall, *Meteorological data collection, *Data acquisition.

A scheme for digitizing daily pluviographs from Dines-type automatic raingauges is described. The data set derived from digitization consists of a division of time into periods of variable length in which rain is assessed as having fallen at a steady rate. The results obtained from the digitized data contain fewer errors than data extracted manually from the pluviographs. It is estimated that 98 percent of the rainfalls in rain periods of any length lie within 0.1 mm of the true amount, and that the time resolution of the system is about 2.5 minutes. (Author's abstract)
W89-03969

DNA AMPLIFICATION TO ENHANCE DETECTION OF GENETICALLY ENGINEERED BACTERIA IN ENVIRONMENTAL SAMPLES,
Louisville Univ., KY. Dept. of Biology.
R. J. Steffan, and R. M. Atlas.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2185-2191, September 1988. 4 fig, 36 ref.

Descriptors: *DNA, *Biodegradation, *Bacterial analysis, *Genetic engineering, *Bacteria, *Pseudomonas, *Water analysis, *Water quality control, *Microbiological studies, Pesticides, Herbicides, Reagents, Sample preparation, Sediments, Biochemical tests.

The polymerase chain reaction (PCR) was performed to amplify a 1.0-kilobase (kb) probe-specific region of DNA from the herbicide-degrading bacterium Pseudomonas cepacia AC1100 in order to increase the sensitivity of detecting the organism by dot-blot analysis. The 1.0-kb region was an integral portion of a larger 1.3-kb repeat sequence which is present as 15 to 20 copies on the P. cepacia AC1100 genome. PCR was performed by melting the target DNA, annealing 24-base oligonucleotide primers to unique sequences flanking the 1.0-kb region, and performing extension reactions with DNA polymerase. After extension, the DNA was again melted, and the procedure was repeated for a total of 25 to 30 cycles. After amplification, the reaction mixture was transferred to nylon filters and hybridized against radiolabeled 1.0-kb fragment probe DNA. Amplified target DNA was detectable in samples initially containing as little as 0.3 pg of target. The addition of 20 micrograms of nonspecific DNA isolated from sediment samples did not hinder amplification or detection of the target DNA. The detection of 0.3 pg of target DNA was at least a 1,000 fold increase in the sensitivity of detecting gene sequences compared with dot-blot analysis of nonamplified samples. PCR performed after bacterial DNA was isolated from sediment samples permitted the detection of as few as 100 cells of P. cepacia AC1100 per 100 g of sediment sample. This represented a 1,000-fold increase in sensitivity compared with nonamplified samples. (Author's abstract)
W89-04002

CALCULATION OF CELL PRODUCTION FROM (H3)THYMIDINE INCORPORATION WITH FRESHWATER BACTERIA,
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
J. D. Smits, and B. Riemann.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 9, p 2213-2219, September 1988. 3 fig, 1 tab, 18 ref.

Descriptors: *Radiochemical analysis, *Bacterial analysis, *Aquatic productivity, *Microbiological studies, *Growth, *Bacterial physiology, Culturing techniques, Culture media, Growth media, Plankton.

The conversion factor for the calculation of bacterial production from rates of (3H)thymidine incorporation was examined with diluted batch cultures of freshwater bacteria. Natural bacterial assemblages were grown in aged, normal, and enriched media at 10 to 20 C. The generation time during 101 growth cycles covered a range from 4 to > 200 h. The average conversion factor was 2.15 x 10 to the 18th power cells/mol of thymidine incorporated into the trichloroacetic acid (TCA) precipitate when the generation time exceeded 20 h. At generation times of < 20 h, the average conversion factor was 11.8 x 10 to the 18th power cells/mol of thymidine incorporated into TCA precipitate. A detailed examination of the (3H)thymidine concentrations that were needed to achieve maximum labeling in DNA was carried out six times during a complete growth cycle. During periods with low generation times and high conversion factors, 15 nM (3H)thymidine was enough for the maximum labeling of the TCA precipitate. This suggests that incorporation of (3H)thymidine into DNA is probably limited by uptake during periods with generation times of < 20 h and that freshwater bacterioplankton cell production sometimes is underestimated when a conversion factor of 2.15 x 10 to the 18th power cells/mol of thymidine incorporated is used. (Author's abstract)
W89-04004

SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHORUS IN RIVER WATER BASED ON THE REACTION OF VANADOMOLYBDOPHOSPHATE WITH MALACHITE GREEN,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, M. Oshima, and A. Hirashima.
Analytica Chimica Acta ACACAM, Vol. 211, No. 1/2, p 119-127, August 15, 1988. 6 fig, 3 tab, 18 ref.

Descriptors: *Natural waters, *Phosphorus compounds, *Water analysis, *Spectrophotometry, *Chemical analysis, *Phosphorus, Dyes, Photometry, Sulfuric acid, Water analysis, Chemical reactions, Reagents, Sample preparation, Detection limits, Silicates, Arsenic compounds, Rivers, Orthophosphates.

The formation of an ion-associate between vanadomolybdophosphate and malachite green in aqueous acidic solution (0.5 M sulfuric acid) enables trace amounts (0-0.00001 M) of phosphate to be determined. The molar absorptivity is 105,000 l/mol/cm at 620 nm. The complex was stabilized in solution by adding poly(vinyl) alcohol. Other ions generally found in river waters did not interfere. Interference by silicate is less than that found in the corresponding malachite green molybdophosphate procedure; interference of arsenate is avoided by reduction with thiosulfate. The method is applied to the determination of micrograms/l amounts of phosphorus in river water; the results obtained were in good agreement with those obtained by an extraction-spectrophotometric method with malachite green. (Author's abstract)
W89-04008

REMOVAL OF IRON FOR THE SPECTROPHOTOMETRIC DETERMINATION OF HUMIC SUBSTANCES IN FRESH WATERS,
Nagoya Univ. (Japan). Faculty of Engineering.
T. Nomizu, M. Sanji, and A. Mizuike.
Analytica Chimica Acta ACACAM, Vol. 211, No. 1/2, p 293-297, August 15, 1988. 1 fig, 3 tab, 7 ref.

Descriptors: *Natural waters, *Water analysis, *Spectrophotometry, *Humic acids, *Iron, Chemical analysis, Cation exchange, Photometry, Reagents, Ion exchange, Resins, Sample preparation, Ammonium compounds.

Iron in natural waters interferes with the spectrophotometric determination of humic substances. A method is described for the removal of most of the iron before the absorbance measurement for the reliable determination of humic substances in fresh waters. More than 95% of the iron was found to be removed by sorption on a cation-exchange resin after reduction to iron (II) with hydroxylammonium chloride at pH 3.5 for 24 hours. The absorbance is then measured at 350 nm. Negatively charged humic substances passed through the resin column quantitatively above pH 3.5. The optimum concentration of hydroxylammonium chloride is about 4,000 times the molar concentration of the iron present. The reducing agent, used at pH 3.5, did not alter the absorption spectra of humic substances at least for a week. (Doria-PTT)
W89-04009

SIMULTANEOUS DETERMINATION OF UREA AND AMMONIA NITROGEN IN SOIL EXTRACTS AND WATER BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Farms of Texas, Alvin.
A. Abshahi, S. S. Goyal, and D. S. Mikkelsen.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 969-973, July/August 1988. 5 fig, 2 tab, 16 ref.

Descriptors: *Soil water, *High-performance liquid chromatography, *Ureas, *Ammonia, *Nitrogen, Chemical analysis, Water analysis, Soil analysis, Chromatography, Sample preparation, Enzymes, Ammonium, Hydrolysis, Chemical reactions, Fluorometry, Fertilizers, Fate of pollutants, Calibrations, Contamination.

Combining the separation efficiency of high performance liquid chromatography (HPLC) and the catalytic solid phase urease reactor, a simple, sensitive, and highly specific method for simultaneous determination of urea and ammonia nitrogen is possible. In this system, the immobilized urease catalyzes the hydrolysis of urea to ammonium ions, which is then measured fluorometrically after post-column derivatization with o-phthalaldehyde (OPA). The fluororphore is detected on-line with a fluorometric detector, 344ex and 455em nm. The method is rapid and can be used to accurately monitor the urea and ammonia-N content of soil, water, and fertilizer materials. (Author's abstract)
W89-04016

JANUARY 1988 WATER LEVELS, AND DATA RELATED TO WATER LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04031

EXPLORATION FOR AREAS SUITABLE FOR GROUNDWATER DEVELOPMENT, CENTRAL CONNECTICUT VALLEY LOWLANDS, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04054

GOES DATA-COLLECTION SYSTEM INSTRUMENTATION, INSTALLATION, AND MAINTENANCE MANUAL,
Geological Survey, Phoenix, AZ. Water Resources Div.
J. W. H. Blee, H. E. Herlong, C. D. Kauffman, M. L. Field, and R. F. iddelburg.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-479, 1986. 173p, 49 fig, 11 tab.

Descriptors: *Data collections, *Remote sensing, *Satellite technology, Data transmission, Data processing, Maintenance, Installation, Gaging stations, GOES satellite, Platform Assignment Scheduling Subsystem.

The purpose of the manual is to describe the installation, operation, and maintenance of Geostationary Operational Environmental Satellite (GOES) data collection platforms (DCP's) and associated equipment. This manual is not a substitute for DCP manufacturers' manuals but is additional material that describes the application of data-collection platforms in the Water Resources Division. Power supplies, encoders, antennas, Mini Monitors, voltage analog devices, and the installation of these at streamflow-gaging stations are discussed in detail. (USGS)
W89-04056

RAINFALL AND RUNOFF QUANTITY AND QUALITY DATA COLLECTED AT FOUR URBAN LAND-USE CATCHMENTS IN FRESNO, CALIFORNIA: OCTOBER 1981 - APRIL 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04065

PROTOCOL FOR COLLECTING, PROCESSING, AND SHIPPING PRECIPITATION SAMPLES,
Geological Survey, Arvada, CO. Water Resources Div.
M. M. Reddy, R. B. See, and T. D. Liebermann.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-405, 1986. 13p, 1 ref.

Descriptors: *Acid rain, *Water analysis, *Monitoring, *Sampling, District of Columbia, Chemistry of precipitation, New Jersey, New York, North Carolina.

This report documents the protocol for collecting, processing, and shipping precipitation samples as part of an investigation of the effects of acid rain on carbonate-rock building materials. The report is Chapter A of a manual for Task Group G site operators participating in the National Atmospheric Deposition Program. The effects of acid rain on carbonate-rock building materials are being investigated at four sites in the eastern United States: Washington, D.C.; Chester, New Jersey; Newcomb, New York; and Research Triangle Park, North Carolina. At each site, precipitation-runoff samples are collected from glass sheets, limestone and marble slabs, and blanks. Precipitation samples also are collected in a wet-only precipitation collector modified for continuous pH measurement. All samples are processed and shipped in the same manner. (USGS)
W89-04091

OPERATIONAL PROTOCOL FOR A RECORDING PRECIPITATION MONITOR,
Geological Survey, Arvada, CO. Water Resources Div.
M. M. Reddy, R. B. See, and T. D. Liebermann.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-405-B, 1986. 24p, 1 ref.

Descriptors: *Acid rain, *Water analysis, *Monitoring, *Sampling, Chemistry of precipitation.

This report documents the protocol for installation, maintenance and calibration of a recording precipitation monitor. The precipitation monitor measures the depth, temperature, pH, and specific conductance of precipitation continuously during a storm event and stores the data on magnetic tape. These instruments are being utilized at four sites in the eastern United State: Washington, D.C.; Chester, New Jersey; Newcomb, New York; and Research Triangle Park, North Carolina. At each site, precipitation is collected in a wet-only precipitation collector modified for continuous monitoring of precipitation chemistry during storms.
W89-04092

GEODETIC TRISECTION, ALTITUDE, AND ICE-RADAR SURVEYING TECHNIQUES USED AT KNIK GLACIER, ALASKA, AND SUMMARY OF 1979, 1980, AND 1981 DATA,
Geological Survey, Fairbanks, AK. Water Resources Div.
For primary bibliographic entry see Field 2C.
W89-04095

TECHNIQUE FOR MAKING FIELD MEASUREMENTS OF OXYGEN IN THE ROOT ZONE OF SATURATED AND UNSATURATED SOILS,
Geological Survey, Reston, VA. Water Resources Div.
V. Carter, D. Shultz, M. K. Garrett, and W. E. Webb.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. In: USGS Water Supply Paper 2262, 1984. p 1-5, 1 fig, 1 tab, 8 ref.

Descriptors: *Oxygen analysis, *Soil oxygen, *Limnology, *Fine-textured soils, *Dissolved oxygen, *Soil gases, *Methodology, *On-site data collection, *Wetlands, *Root zone, Oxygen requirements, Saturated zone, Unsaturated zone, Oxygen, Electrodes.

The rapid, accurate measurement of the oxygen content of soil gas in the unsaturated zone or dissolved oxygen (DO) of the soil water in the saturated zone can be useful in wetland vegetation studies. A methodology has been devised and tested in the Great Dismal Swamp, a wetland with fine silt-clay and organic soils that appears to provide good results. A 60-milliliter sample of soil gas or water is withdrawn from permanently installed chambers at various depths in the soil profile. The oxygen concentration of an air sample is measured using a specially machined analyzer cell fitted to the polarographic oxygen electrode connected to a portable oxygen meter. The dissolved oxygen concentration of a water sample is measured with the oxygen electrode directly, while stirring the sample in a 32-milliliter glass bottle with a portable magnetic stirrer. Field tests with duplicate chamber installations showed that the method gives consistent results for both soil gas and water. (USGS)
W89-04096

SURFACE-RUNOFF MEASUREMENT AND SEDIMENT-SAMPLE-COLLECTION SYSTEM FOR SMALL AREAS,
Geological Survey, Urbana, IL. Water Resources Div.
J. R. Gray, and M. P. deVries.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. In: USGS Water Supply Paper 2262, 1984. p 7-11, 1 fig, 1 tab, 8 ref.

Descriptors: *Runoff, *Sediment yield, *Erosion, *Sampling, *Data collections, *Radioactive wastes, *Hazardous wastes, *Runoff plots, *Illinois, Rainfall-runoff relationships.

A system has been developed for measuring surface runoff and collecting water-sediment samples from small areas (plot) on a low-level radioactive waste disposal site in northwestern Illinois. Runoff from a 11-square-meter plot is routed through a Parshall flume. Peak discharge is computed from a peak stage measured in a flume stilling well and a stage-discharge relation for the flume. The flume discharges into a 20-liter primary collecting vessel. Runoff exceeding 16 liters is pumped from the primary vessel until 4 liters remain. Pumpage is routed through a cone-splitting chamber, a sub-unit of the U.S. Geological Survey cone splitter, which divides flow into 10 equal parts. One part is retained in addition to that stored by the primary vessel for subsequent measurement and sediment-sample collection. The device, called the dekaport divisor system, enables collection of reliable runoff and sediment yield data from small plots. (USGS)
W89-04097

SOLUTION-CHEMISTRY MODEL OF THE INTERFERENCE OF CADMIUM-CARBONATE PRECIPITATION IN THE DETERMINATION OF CATION-EXCHANGE SEPARATION FACTORS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-04100

CONFIDENCE LIMITS FOR DETERMINING CONCENTRATIONS OF TRACER PARTICLES IN SEDIMENT SAMPLES,
Geological Survey, Denver, CO. Water Resources Div.
C. F. Nordin, and P. W. Mielke.
Available from Supt. of Docs, GPO, Washington, D. C. 20402. In: USGS Water Supply Paper 2262, 1984. p 43-46, 2 fig, 4 ref.

Descriptors: *Tracer particles, *Tracers, *Sediments, *Sediment transport, *Sediment tracers, Sample concentrations, Sampling, Data collections.

Tracer-particle techniques often are used in sediment transport studies. The concentration of tracers is estimated by counting X tracer particles in a sample of size n. The sample concentration is an estimate of the concentration C of the population from which the sample was drawn. The confidence limits for the sample concentrations are derived under the assumption that each particle in the sample has the probability C of being a tracer. (USGS)
W89-04101

DETERMINATION OF AQUATIC HUMIC SUBSTANCES IN NATURAL WATERS,
Geological Survey, Lakewood, CO. Water Resources Div.
E. M. Thurman.
Available from Supt. of Docs, GPO, Washington, D. C. 20402. In: USGS Water Supply Paper 2262, 1984. p 47-52, 1 fig, 1 tab, 28 ref.

Descriptors: *Aquatic humic substances, *Humic acids, *Humic substances, *Water analysis, *Natural waters, *Dissolved humic substances, Adsorption.

Aquatic humic substances in 50-ml samples are measured at the microgm/liter level following desorption of the adsorbed humic material from a macroporous resin with 0.1 normal sodium hydroxide. The resulting eluate is quantified by dissolved organic carbon analysis. The method is quantitative, rapid, simple, and inexpensive. (USGS)
W89-04102

GROUND-PENETRATING RADAR STUDY OF THE THICKNESS AND EXTENT OF SEDIMENTS BENEATH SILVER LAKE, BERLIN AND MERIDEN, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
F. P. Haeni, D. K. McKeegan, and D. R. Capron.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4108, 1987. 19p, 11 fig, 2 tab, 13 ref.

Descriptors: *Lakes, *Sediments, *Bottom sediments, *Connecticut, *Surface geophysical techniques, *Land penetrating radar, Organic sediment, Silver Lake, Geophysics, Radar, Hydrology, Groundwater, Limnology.

A short-pulse ground-penetrating radar system was used to determine the extent and thickness of organic-rich lake-bottom sediments in Silver Lake in south-central Connecticut. Four mi of ground-penetrating radar profiles were obtained along traverses of the frozen lake during March 1984. The radar waves penetrated 6 inches of snow, 1 ft of ice, an average of 4 to 5 ft of water, and 5 ft of soft organic and inorganic deposits. A large area of the lake bottom is underlain by soft sediment exceeding 5 ft in depth. No radar reflections were obtained from the hard subbottom in these areas because the overlying sediment probably contains large proportions of silt and clay that are relatively impervious to radar. Coring along two radar profile lines confirmed the depths of soft sediment calculated from the radar data. Boring logs around the perimeter of the lake indicate that the eastern side may be underlain by till or poorly-sorted sand and gravel, and that the rest of the lake is probably underlain by fine sands and silts with some discontinuous layers of sand and gravel. (USGS)
W89-04107

RETENTION TIME AND FLOW PATTERNS IN LAKE MOULTRIE, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04108

RISK-BASED SELECTION OF MONITORING WELLS FOR ASSESSMENT OF AGRICULTURAL CHEMICAL CONTAMINATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-04127

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT IN THE 1986 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04137

WATER RESOURCES REPORTS PREPARED BY THE U.S. GEOLOGICAL SURVEY, TEXAS DISTRICT, 1973-86,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-04141

EVAPOTRANSPIRATION AND MICROCLIMATE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE IN NORTHWESTERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2D.
W89-04159

U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN WEST-CENTRAL FLORIDA WITH A SECTION ON HISTORY OF THE STREAM GAGING PROGRAM IN FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04167

DESCRIPTION AND HYDROGEOLOGIC EVALUATION OF NINE HAZARDOUS-WASTE SITES IN KANSAS, 1984-86,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04171

FLOW-PROPORTIONAL WATER SAMPLER FOR USE IN CONJUNCTION WITH A V-NOTCH WEIR IN SMALL CATCHMENT STUDIES,
Welsh Plant Breeding Station, Aberystwyth.
S. P. Cuttle, and D. J. Mason.
Agricultural Water Management AWMADF, Vol. 13, No. 1, p 93-99, April 1988. 3 fig, 2 ref.

Descriptors: *Water sampling, *Data acquisition, *Weirs, Catchment basins, Design criteria, Performance evaluation, Samplers.

A flow-proportional water sampler has been constructed which collects a water sample over a weekly period, taking a sample increment every 30 min. The device is linked to a V-notch weir and consists of a vertical chamber with an inlet at the base connected to a tube inserted through the weir plate. At 30-min intervals a timer operates a battery-powered solenoid valve, which opens the inlet and allows water to fill the chamber to a level equal to the level behind the weir. The shape of the chamber is such that, at any head of water, the volume of water it contains is proportional to the flow. The valve then returns to its resting state, closing the inlet and opening an outlet to allow the contents of the chamber to drain into a storage container. Two such devices have been operated successfully at a remote field site. The volumes of water collected over weekly sampling periods (30-700 cu m/wk) were closely correlated with the measured weekly flows. (Author's abstract)
W89-04211

V-NOTCH WEIR BOXES FOR MEASUREMENT OF SUBSURFACE DRAINAGE SYSTEM DISCHARGES,
Agriculture Canada, Fredericton (New Brunswick). Research Station.
P. Milburn, and J. Burney.
Canadian Agricultural Engineering CAEOAI, Vol. 30, No. 2, p 209-212, July 1988. 3 fig, 1 tab, 5 ref.

Descriptors: *Discharge measurement, *Gaging, *Data acquisition, *Field equipment, *Weirs, *Drainage systems, *Subsurface drainage, Water sampling, Catchment basins, Design criteria, Performance evaluation, Samplers.

Portable discharge measurement structures that accurately measure the range of outflows common to field-scale subsurface drainage systems are not readily available at reasonable cost. Construction drawings and calibration results are presented for two non-90-degree, sharp-crested, V-notch weir boxes designed to discharge a maximum of 10 and 20 L/s at 300 mm of head. The completed structures are light-weight, durable, compact in size, simple to construct, and baffled to reduce turbulence in the approach section to the notch. (Author's abstract)
W89-04216

DETAILS OF THE FLOW AND BOTTOM PRESSURE DOWNSTREAM OF A THIN-PLATE WEIR,
Cambridge Univ. (England). Dept. of Engineering.
For primary bibliographic entry see Field 8B.
W89-04276

DIELECTRIC TENSIOMETER,
Technical and Physical Engineering Research Service for Agriculture, Wageningen (Netherlands).
M. A. Hilhorst, and J. J. De Jong.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 411-415, June 1988. 2 fig, 3 ref.

Descriptors: *Tensiometers, *Soil water, *Measuring instruments, Dielectric tensiometer.

A new technique for measuring soil water tension uses the relation between the dielectric behavior and the water tension of an absorbent placed in the soil. The dielectric tensiometer consists of a porous metal cylinder as an outer conductor, with an inner conductor, and filled with glass beads which serve as an absorbent. Together they form a coaxial condenser system. The electrical capacitance between the two electrodes is a measure for the soil water tension. The dielectric tensiometer is usable from 0-10 bar, without suffering from most of the common disadvantages of tensiometer pressure transducer systems. The dielectric tensiometer is ideally suited for use in conjunction with a capacitive soil water content meter for determining the water-retention characteristics of soil material. (Author's abstract)
W89-04280

MOBILE SOUNDING OBSERVATIONS OF A TORNADIC STORM NEAR THE DRYLINE: THE CANADIAN, TEXAS STORM OF 7 MAY 1986,
Oklahoma Univ., Norman. School of Meteorology.
H. B. Bluestein, E. W. McCaul, G. P. Byrd, and G. R. Woodall.
Monthly Weather Review MRWEAB, Vol. 116, No. 9, p 1790-1804, September 1988. 17 fig, 1 tab, 34 ref, append.

Descriptors: *Weather data collections, *Weather, *Storms, *Telemetry, *Tornadoes, Mobile sounding units, Texas, National Severe Storms Laboratory, Tornado Intercept Project.

On 7 May 1986 thunderstorms formed during the afternoon near a dryline in the Texas Panhandle under weak synoptic-scale forcing. Five tornadoes and large hail were produced by one storm near Canadian, Texas. Soundings obtained by a storm-intercept team with a portable sounding unit were analyzed. A sounding launched into the wall cloud of the storm just after the fourth tornado indicated a nearly pseudomoist adiabatic lapse rate, a temperature excess of 10 C over the environment at 500 mb, and an updraft speed of almost 50m/s near 6 km AGL, in reasonable agreement with parcel theory. (Author's abstract)
W89-04284

POSSIBLE RAINFALL MECHANISM IN THE OROFURE MOUNTAIN RANGE, HOKKAIDO, JAPAN-THE RAINFALL ENHANCEMENT BY A TWO-LAYER CLOUD STRUCTURE,
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2B.
W89-04286

EVALUATION OF VOLTAMMETRIC TITRATION PROCEDURES FOR THE DETERMINATION OF TRACE METAL COMPLEXATION IN NATURAL WATERS BY USE OF COMPUTER SIMULATION,
Water Research Centre, Medmenham (England).
S. C. Apte, M. J. Gardner, and J. E. Ravenscroft.
Analytica Chimica Acta ACACAM, Vol. 212, No. 1-2, p 1-21, September 15, 1988. 3 fig, 8 tab, 57 ref.

Descriptors: *Water analysis, *Model studies, *Trace metals, *Heavy metals, *Graphical methods, *Graphical analysis, Error analysis, Computer models, Voltammetric titration, Trace metal complexation, Cathode stripping voltammetry, Anode stripping voltammetry, Ligands, Scatchard graphs, Van den Berg/Ruzic graphs.

The impact of random analytical errors on the determination of metal complexation parameters of natural waters by metal titration procedures based on cathodic stripping (CSV) or anodic stripping (ASV) voltammetry was investigated by means of computer simulation. The results indicate that random analytical errors are of overriding importance in establishing the range of ligand concentrations and conditional stability constants that can be accurately determined by these techniques. Simulations incorporating realistic estimates of random analytical error show that only stability constants lying within a relatively narrow range, typically three orders of magnitude, can be determined accurately by the anodic stripping procedure. The cathodic procedure suffers from the same limitations, but is potentially more flexible in that the available detection window can be moved, but not widened. Both techniques are capable of accurately determining ligand concentrations accurately under specified stability constant conditions. Simulations using the Scatchard and Van den Berg/Ruzic graphical treatments indicate the Vanden

Berg/Ruzic method is superior for the single-ligand model of complexation. The value of computer simulations when complex, time-consuming analytical techniques are applied and the need for rigorous analysis of errors in producing data of environmental relevance is demonstrated. (Authors abstract)
W89-04288

FLUORESCENCE QUENCHING MEASUREMENTS OF COPPER-FULVIC ACID BINDING,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2K.
W89-04290

COMPARISON OF RADAR AND GAUGE MEASUREMENTS OF RAINFALL OVER WALES IN OCTOBER 1987,
Meteorological Office, Bracknell (England).
T. J. Hitch, and B. D. Hems.
Meteorological Magazine MTMGA5, Vol. 117, No. 1394, p 276-279, September 1988. 4 fig, 2 ref.

Descriptors: *Weather data collections, *Rain gages, *Radar, Wales, England, Precipitation, Rainfall.

Comparisons are made of radar and gage measurements of rainfall totals over Wales and nearby areas for the period 14 to 19 October 1987. Up to distances of about 130 km from the Clee Hill radar, the radar-measured rainfall amounts are mainly within one half to twice the rainfall measured by co-located gages, but beyond this distance the radar increasingly underestimates the gage rainfall. (Author's abstract)
W89-04292

USE OF WEATHER RADAR IN ASSESSING DEPOSITION OF RADIOACTIVITY FROM CHERNOBYL ACROSS ENGLAND AND WALES,
Imperial Coll. of Science and Technology, London (England). Air Pollution Group.
For primary bibliographic entry see Field 5B.
W89-04298

SCREENING AND BIOMONITORING OF INDUSTRIAL EFFLUENTS USING PHYTOTOXICITY TESTS,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5A.
W89-04334

COMPUTER-AIDED DESIGN FOR CHANNELIZATION,
San Diego State Univ., CA. Dept. of Chemistry.
For primary bibliographic entry see Field 8B.
W89-04362

GROUNDWATER QUALITY: A DATA ANALYSIS PROTOCOL,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5A.
W89-04368

ANALYTICAL TRANSIENT EQUATIONS FOR DRAINS IN ARTESIAN AREAS,
Ministry of Irrigation, Cairo (Egypt).
For primary bibliographic entry see Field 3F.
W89-04379

USING LIGHTNING FOR RAINFALL ESTIMATION IN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W89-04380

PREDICTION OF DRAIN SILTING BY SOIL AGGREGATE SIZE ANALYSIS,
Laval Univ., Quebec.
For primary bibliographic entry see Field 2J.
W89-04383

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART II. MODEL SENSITIVITY ANALYSIS AND TESTING,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W89-04385

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS: 1. MATHEMATICAL DESCRIPTION AND MODEL REPRESENTATION,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-04390

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS: 2. MODELLING OF THE STEADY STATE CASE,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-04391

MODELLING TECHNIQUES FOR BIOLOGICAL REACTION SYSTEMS 3. MODELLING OF THE DYNAMIC CASE,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-04392

USE OF THE EINSTEIN ENTRAINMENT FUNCTION FOR PREDICTING SELECTIVE ENTRAINMENT AND DEPOSITION OF HEAVY MINERALS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-04393

ANALYSIS OF LOW MOLECULAR WEIGHT ALDEHYDES CAUSING ODOUR IN DRINKING WATER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-04395

EFFECT OF BASE ON THE C-13 NMR SPECTRA OF MODEL PHENOLIC ACIDS RELATED TO HUMIC ACIDS AND LIGNINS,
Arizona Univ., Tucson. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W89-04398

FIELD ASSESSMENT OF SEDIMENT TRAP EFFICIENCY UNDER VARYING FLOW CONDITIONS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2J.
W89-04422

BAULE-MITSCHERLICH LIMITING FACTOR EQUATION EVALUATED IN FRESHWATER HABITATS,
Southern Illinois Univ., Carbondale. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-04486

LIMITATION TO THE USEFULNESS OF CHLOROPHYLL AS A BIOMASS INDICATOR IN EUTROPHICATION STUDIES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
E. White, G. Payne, and S. Pickmere.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen IVTLAP, Vol. 23, No. 1, p 598-601, January 1988. 1 fig, 3 tab, 10 ref.

Descriptors: *Bioindicators, *Eutrophication, *Chlorophyll A, *Biomass, *Limnology, *Phytoplankton, *Lakes, Plankton, Aquatic plants, Algae, Carbon, Nitrogen, Phosphorus, Nutrients, Trophic level.

Chlorophyll a is generally accepted as an estimator of phytoplankton biomass in eutrophication studies. Culture studies have demonstrated how chlorophyll a and other chemical components of algae interact under variable conditions of light and nutrient limitations, but transfer of this information to interpret features of natural situations is inhibited by concern about the size of the detrital component. Nevertheless, ratios of chlorophyll a to cell volume and chlorophyll a to elemental concentrations such as particulate carbon, particulate nitrogen, and particulate phosphorus in natural waters often vary systematically in ways that point to the influence of light and nutrient availability, so that studies linking chlorophyll a to seston elemental content may advance knowledge providing the limitations of the approach are not forgotten. It is concluded that if a eutrophication control program seeks only to make a eutrophic lake less eutrophic, then prediction of the effect of reducing the lake nutrient content upon chlorophyll a content would best be made using data from eutrophic waters only. The inclusion of data from oligotrophic and mesotrophic waters will allow the generation of relationships that will be overly optimistic about the chlorophyll a reduction likely to be achieved. (Author's abstract)
W89-04538

7C. Evaluation, Processing and Publication

COMPUTER CODES FOR THREE DIMENSIONAL MASS TRANSPORT WITH NONLINEAR SORPTION,
British Geological Survey, Keyworth (England). Fluid Processes Research Group.
For primary bibliographic entry see Field 5B.
W89-03340

APPLICATION OF LANDSCAPE SEDIMENT MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-03354

DATA-BASED WATER QUALITY INFORMATION SYSTEM,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5F.
W89-03360

PARTICIPATION IN THE PRECIPITATION CHEMISTRY NETWORK: PROGRESS REPORT, 1 DECEMBER 1986 TO 31 JULY 1987.
Pennsylvania State Univ., University Park.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003139. Price codes: A02 in paper copy, A01 in microfiche. Report No. DOE/ER/60294--1, (1987). 5p, 1 fig, 1 tab.

Descriptors: *Acid rain, *Chemistry of precipitation, *Hydrogen ion concentration, Data interpretation, Conductivity, Monitoring, Sampling, Comparison studies.

Site operations for the Precipitation Chemistry Network included collection of precipitation event samples, measurement and reporting of sample pH and conductivity and precipitation depths, and servicing of the collectors and site as necessary.

Per MAP3S protocol all samples were shipped to the analytical laboratories at Pacific Northwest Laboratories (PNL) for more detailed analysis. No significant problems in site operations were encountered over the reporting period. Comparisons between the precipitation pH values measured at site laboratories and those measured in the primary laboratory at PNL have been made. This is partly an effort to assess the effects of sample storage and shipping and partly for the purpose of tracking the quality of sample-handling procedures. While the correlation coefficient is relatively high, 0.98, suggesting overall good preservation of sample quality, several marked departures from agreement occur in specific instances. Large differences in isolated cases may be evidence for sample contamination due to mishandling of the sample subsequent to pH analysis in the field laboratory. Also evident is a systematic bias, which increases toward higher pH values and amounts to about 0.05 pH units at pH 3.5 and 0.15 pH units at pH 5.0. The cause of this deviation has not yet been determined. (Lantz-PTT)
W89-03384

MODELING STUDY OF THE EFFECT OF PH ON CARBON LIMITED ALGAL BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-03441

PRELIMINARY EMPIRICAL MODELS OF THE HISTORICAL AND FUTURE IMPACT OF ACIDIFICATION ON THE ECOLOGY OF WELSH STREAMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W89-03503

SEASONAL CHANGES IN SEDIMENT AND WATER CHEMISTRY OF A SUBTROPICAL SHALLOW EUTROPHIC LAKE,
Central Florida Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 2H.
W89-03558

INTELLIGENT DATA ANALYZER: HERBICIDE TRANSPORT IN THE CEDAR RIVER, IOWA,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W89-03598

SELECTION OF TREND ANALYSIS TECHNIQUES FOR WATER QUALITY DATA,
Office of the Assistant Secretary for Water and Science, Washington, DC.
For primary bibliographic entry see Field 5A.
W89-03599

DATA CHARACTERISTICS: GROUNDWATER MONITORING'S 'CATCH 22',
IBM Corp., Hopewell Junction, NY. General Technology Div.
H. F. Bell, and H. P. DeLong.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 20-24. 2 tab, 2 fig, 4 ref.

Descriptors: *Hydrologic data, *Data analysis, *Groundwater, *Groundwater management, *Data interpretation, *Water quality, *Statistical methods, Monitoring wells, Seasonal variations.

The role and importance of data characterization in groundwater monitoring is reviewed. The limitations of the data characterization procedure are discussed and alternative approaches for data analysis, not subject to the problems associated with the common characteristics of groundwater data, are suggested. Each characterization step was carried out using parametric, nonparametric and visual procedures. The combined results of these tests were used in making decisions concerning the data set characteristics. Analysis of water samples, collected from a shallow monitoring well, resulted in a long monthly data record of water quality data (chlorinated hydrocarbons) which contained very few missing or censored values. The characterization of the data set indicated that the data was seasonal, had a slight positive trend, was normally distributed and showed a significant serial correlation. The characterization represents a Catch-22 situation in that the data is required before you begin to collect it. An alternative approach (a data analysis protocol), which would allow one to provide statistically sound information early in the groundwater program, is suggested. The data analysis protocol was developed by IBM and Colorado State University. It is designed to be insensitive to the distribution of data and to take seasonality and serial correlation into account. It provides answers to the main concerns of the monitoring programs: (1) what is the average condition, (2) is there a trend, and (3) are there excursions of limits or standards. The protocol provides users of environmental monitoring network data with an approach that is consistent, timely, easy to carry out and insensitive to the common characteristics of groundwater data that result in the Catch-22 situation. (See also W89-03595) (Miller-PTT)
W89-03600

PARTIAL RANK CORRELATION TEST IN WATER QUALITY DATA ANALYSIS,
University of Western Ontario, London. Dept. of Statistical and Actuarial Sciences.
P. D. Valz, B. Bodo, A. I. McLeod, and K. W. Hipel.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 25-26. 7 ref.

Descriptors: *Statistical analysis, *Water quality, *Data interpretation, *Correlation analysis, Mathematical studies, Toxicity, Pollutant identification, Kendall's partial rank correlation test.

Kendall's partial rank correlation test was described and used to study the statistical characteristics of water quality variables which include toxic compounds. The partial rank correlation test is a nonparametric test that can be used to detect trends in messy water quality data which may be non-normally distributed, have many missing values, possess many observations which fall below detection limits, and follow cyclic seasonal patterns. When examining a mulitvariate suite of water quality variables, the partial rank correlation test can be employed in a number of innovative ways. To check for the presence of trends in seasonal data, the seasonal effects can first be removed or partialled out. One can also eliminate the influence of one variable on another before testing for the existence of trends. Finally, one can examine the relationship between two variables after partialling out the effects of a third controlling variable. (See also W89-03595) (Author's abstract)
W89-03601

STATISTICAL COMPARISONS OF GROUNDWATER QUALITY UNDERLYING DIFFERENT LAND USES IN CENTRAL FLORIDA,
Kansas State Geological Survey, Lawrence.
A. T. Rutledge, and E. R. German.
IN: Preprints of Papers Presented at the 196th ACS National Meeting. Vol. 26, No. 2. Division of Environmental Chemistry, American Chemical Society, Washington, DC. 1988. p 27-29. 1 fig, 4 ref.

Descriptors: *Water quality, *Groundwater, *Florida, *Data interpretation, *Statistical analysis, *Land use, Physical properties, Chemical properties, Phosphates, Citrus fruits, Agriculture.

Statistical comparisons of groundwater quality were made for an undeveloped control area, a citrus-growing area and a phosphate-mining area in Central Florida. Comparisons focus on physical properties, major ions, nutrients, and trace elements in water from the surficial aquifer. Parametric procedures are effective only for the analysis of physical properties and major ions because of the lack of normality in the distributions of other variables. With the exception of pH, all complete sets of parametric comparisons require the conversion of data to logarithms of data. Nonparametric procedures can be used on all types of data because of the absence of a requirement for normality. There are demonstratable relations between land use and the levels at which water quality variables occur in groundwater. Some variables act as 'indicators of particular land uses, whereas others tend to occur at elevated levels under many different land uses. (See also W89-03595) (Author's abstract)
W89-03602

PREDICTION OF RAINWATER ACIDITY USING TRACE ELEMENT CONCENTRATIONS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-03603

HYDROLOGIC DATA FOR CECIL COUNTY, MARYLAND,
Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2E.
W89-03758

GROUND-WATER LEVELS FROM THE MARYLAND OBSERVATION-WELL NETWORK, 1943-86,
Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2F.
W89-03760

USE OF WATER IN ARKANSAS, 1985,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-03763

WATER RESOURCES OF SOUTHERN COCONINO COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-03764

APPRAISAL OF THE GROUNDWATER RESOURCES OF BARTON, VERNON, AND BATES COUNTIES, MISSOURI,
Geological Survey, Rolla, MO.
For primary bibliographic entry see Field 2F.
W89-03780

WATER RESOURCES INVESTIGATIONS IN MISSISSIPPI, 1982-83.
Geological Survey, Jackson, MS. Water Resources Div.
Compiled by C. Bentley and A. G. Lamonds. March 1983. 91p.

Descriptors: *Water resources investigations, *Mississippi, *Data acquisition, *Hydrologic data collections, Precipitation, Aquifers, Groundwater supply, Water resources development, Water management.

Progress made by the USGS Water Resources Division in water resources investigations and related activities in Mississippi during the fiscal year ending September 30, 1982, is summarized and work to be accomplished during the fiscal year ending September 30, 1983 is outlined. The specific purpose of the report is to inform cooperating State, local, and other Federal agencies about all activities of this Division in water investigations in Mississippi and to give those cooperators a better understanding of how their participation fits into the total USGS program of water resources investigations. Ongoing investigations include: surface water data collection, groundwater data collection, water quality data collection, precipitation quality data collection, potentiometric mapping of aquifers

in Mississippi, flow characteristics of the Tombigbee River, and a synoptic study of the Mississippi River Valley alluvial aquifer in the Yazoo Basin, Mississippi. (Lantz-PTT)
W89-03781

SIMPLIFIED SENSITIVITY ANALYSIS APPLIED TO A NUTRIENT-BIOMASS MODEL,
Saint Martin's Coll., Lacey, WA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W89-03824

PHYSICAL AND CHEMICAL STUDIES ON THE SEDIMENTS OF THE ST-POINT LAKE (JURA MOUNTAINS): CARTOGRAPHY (ETUDE PHYSICO-CHIMIQUE DES SEDIMENTS DU LAC DE ST-POINT (MASSIF DU JURA): CARTOGRAPHIE THEMATIQUE),
Universite de Franche-Comte, Besancon (France). Lab. d'Hydrobiologie - Hydroecologie.
For primary bibliographic entry see Field 2J.
W89-03843

WATER QUALITY VARIATIONS DURING A FLOOD EVENT IN THE ANNAN RIVER, NORTH QUEENSLAND,
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
For primary bibliographic entry see Field 5B.
W89-03856

1988 NATIONAL WATER RATE SURVEY,
Young (Arthur) and Co., Charlotte, NC.
For primary bibliographic entry see Field 6C.
W89-03879

CULTIVATING CONSUMER CONFIDENCE THROUGH COMMUNICATION,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
D. P. Wendel.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 10, p 34-36, October 1988.

Descriptors: *Communication, *Public relations, *Public opinion, Water management, Attitudes, Future planning, South Carolina.

The old adage - 'How you communicate is as important as what you communicate' - is especially true regarding public relations between a water utility and its customers. A utility has to be a visible part of the community, and it must communicate on a regular basis with its constituency. Experiences of the Grand Strand Water and Sewer Authority (GSWSA) located on the South Carolina Grand Strand, are detailed. The first and most important step is to retain a professional public relations firm. In communicating to consumers, indirect communication through positive news stories can do more to boost a utility's image than any number of advertising campaigns. In addition, direct mailings of newsletters and inserts in billings, help to keep the public informed. The GSWSA also holds public hearings on major issues of interest to the community, meets regularly with community leaders and public officials, maintains an after-hours emergency response answering service for customers, and periodically surveys customers for opinions. (VerNooy-PTT)
W89-03884

COKRIGING POINT DATA ON MOISTURE DEFICIT,
Department of Soil Statistics, Agricultural University, Box 37, 6700 AA Wageningen, The Netherlands.
For primary bibliographic entry see Field 2G.
W89-03902

STATISTICAL ISSUES AND PROBLEMS IN GROUND WATER DETECTION MONITORING AT HAZARDOUS WASTE FACILITIES,
Toledo Univ., OH. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 7A.
W89-03929

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: I. A CONCEPTUAL INTRODUCTION,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Corwin, J. W. Werle, and J. D. Rhoades.
Hilgardia, Vol. 56, No. 2, p 1-17, May 1988. 13 fig, 1 tab, 35 ref.

Descriptors: *Irrigation effects, *Data processing, *Mapping, *Salinity, *Saline soils, *Land management, Soil types, Clays, Perched water table, Permeability, Irrigation efficiency, Profiles, Soil profiles, Zones, Arid zone, Computer programs, Computers.

Several interacting factors are generally associated with the development of soil salinity on irrigated lands of the arid Southwest. Notable examples include physical edaphology (clay content and soil permeability), depth to the perched water table, salinity of the perched groundwater, and irrigation efficiency. By creating map overlays of these properties and noting the areas of intersection of specific levels or thresholds of these properties, areas can be delineated that demonstrate varying propensities for salt accumulation in the soil profile. Utilizing an automated geographic information system (GIS), a conceptual approach to delineating areas with similar propensities for the development of soil salinity on irrigated arid-zone soils is presented. The computer mapping strategies provide an efficient and accurate means of organizing, compiling, analyzing, and displaying complex interrelated data bases that are associated with soil salinization. A map can easily be made from the data to aid in land and irrigation management decision making. The automated GIS is capable of performing mapping tasks generally reserved for larger and more expensive computer systems. The mapping system's polygonal spatial data base maximizes spatial accuracy and produces maps that are aesthetically pleasing and easy to interpret. (See also W89-03985) (Author's abstract)
W89-03984

USE OF COMPUTER-ASSISTED MAPPING TECHNIQUES TO DELINEATE POTENTIAL AREAS OF SALINITY DEVELOPMENT IN SOILS: II. FIELD VERIFICATION OF THE THRESHOLD MODEL APPROACH,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Corwin, and J. D. Rhoades.
Hilgardia, Vol. 56, No. 2, p 18-32, May 1988. 7 fig, 5 tab, 7 ref.

Descriptors: *Model studies, *Computer programs, *Saline soils, Model testing, Computer models, Soil types, Forecasting, Yuma, Arizona, Groundwater, Permeability, Leaching, Salinity.

A study area within the Wellton-Mohawk Irrigation District, which lies east of Yuma, AZ, was used to verify the threshold model proposed in Part I. Verification results showed that the threshold model could not reliably predict salinization potential; consequently, a modified threshold model, Model I, was formulated. Model I was capable of predicting nearly 60% of the salinization potentials correctly, a significant improvement over the original threshold model. Nevertheless, Model I fell short of being considered a reliable forecasting tool. It is postulated that the interactions between the factors believed to give rise to salinity development at the study site were too complex to characterize with the simple threshold model approach. Rather, a means of weighting the significance of the individual factors in the overall salinization process may be necessary. (See also W89-03984) (Author's abstract)
W89-03985

CHEMICAL AND HYDROLOGIC DATA FOR SELECTED THERMAL-WATER WELLS AND NONTHERMAL SPRINGS IN THE BOISE AREA, SOUTHWESTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young, D. J. Parliman, and R. H. Mariner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $6.25, microfiche $4.00. USGS Open-File Report 88-471, Sept. 1988. 35p, 5 fig, 3 tab.

Descriptors: *Water quality, *Hydrologic data, *Thermal water, *Springs, *Idaho, Wells, Boise.

Data were collected during January to July 1988 from 37 thermal-water wells and 3 nonthermal springs in the Boise area, southwestern Idaho. Included are well and spring locations; well-construction, water-level, and water-use information; hydrographs of water levels in 3 wells; chemical and isotopic analyses of water from 18 thermal-water wells and 3 nonthermal springs; and drillers' logs from 23 wells. The purpose of the report is to make these data conveniently available to the public. (USGS)
W89-04028

ESTIMATED WATER USE IN SOUTH DAKOTA, 1985,
Geological Survey, Huron, SD. Water Resources Div.
R. D. Benson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-313, 1988. 1 sheet.

Descriptors: *Water use, *South Dakota, *Maps, Surface water, Groundwater, Hydrologic data, Data collections.

Water use in South Dakota during 1985 is estimated to have been 674 million gal/day. This is a slight decrease from the 1980 estimate of 690 million gal/day. Of the total use, 63% was from surface-water sources and 37% was from groundwater sources. About 75% of the total water use was for agriculture, 16% was for domestic and commercial use, 8% was for industrial and mining use, and 1% was for thermoelectric and geothermal uses. Of the total used, 361 million gal/day were consumed and 313 million gal/day were returned to the surface- and groundwater system. Water use by agriculture, the largest user, was mostly for irrigation. Total use was 516,000 acre-ft (460 million gal/day) for irrigation of 397,000 acres. Non-irrigation use, mainly for livestock, was 47.1 million gal/day. About 12% of the total use was by public-water suppliers. Seventy-five percent of the deliveries by public-water suppliers were for domestic use by 78% of the population. In addition to offstream use, instream use was substantial because of hydroelectric-power generation by the four dams on the Missouri River. During 1985, 60,500 million gal/day were used to generate 6,095 gigawatt-hr of electricity. (USGS)
W89-04034

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1987,
Geological Survey, Tampa, FL. Water Resources Div.
B. R. Lewelling.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-303, 1988. 1 sheet, 7 fig, 4 ref.

Descriptors: *Potentiometric surface, *Maps, *Groundwater flow, *Florida, Hydrology, Geohydrology.

A September 1987 potentiometric-surface map of the intermediate aquifer system in west-central Florida depicts water levels for the annual high water-level period. Hydrographs show seasonal and annual changes that range from 0 to 30 ft or more in some years. September 1987 water levels averaged about 3 ft higher than May 1987 levels and about 2 ft lower than September 1986 levels. (USGS)
W89-04036

MAP SHOWING DEPTH TO BEDROCK, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Glass.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-198, 1988. 1 sheet, 3 refs.

Descriptors: *Alaska, *Anchorage, *Bedrock, *Geology, *Maps, Water availability, Drillers logs, Geohydrology, Aquifers.

Knowledge of the physical and hydrologic characteristics of geologic materials is useful in determining the availability of groundwater for public and domestic supply and the suitability of areas for on-site septic systems. A generalized map of the Anchorage area shows the approximate distance from land surface to the top of the bedrock surface. Four depth zones are shown. The depths were determined from lithologic data contained in drillers' logs. (USGS)
W89-04037

OKLAHOMA, A SUMMARY OF ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, IN FISCAL YEARS 1986-87,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-04038

APPROXIMATE CHANGE IN WATER LEVELS IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-88 AND 1987-88, AND MEASURED COMPACTION, 1973-88, IN THE HOUSTON-GALVESTON REGION, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
R. K. Gabrysch, C. E. Ranzau, and L. S. Coplin.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 88-168, 1988. 7 sheets, 6 fig.

Descriptors: *Texas, *Maps, *Groundwater level, *Withdrawal, *Subsidences, *Monitoring, Water levels, Water-level fluctuations, Compaction, Houston-Galveston region.

This report consists of: (1) four maps that present data on water level changes during 1977-88 and 1987-88 in the Chicot and Evangeline aquifers in the Houston area of Texas, and (2) one set of graphs and one map that present data on the compaction of subsurface materials for 1973-88. (USGS)
W89-04040

STATION DESCRIPTIONS AND AVAILABILITY OF DISCHARGE AND WATER QUALITY DATA THROUGH 1985 FOR EASTERN MONTANA STREAM SITES NOT INCLUDED IN THE NATIONAL WATER DATA EXCHANGE PROGRAM,
Geological Survey, Billings, MT. Water Resources Div.
B. L. Groskinski-Link, and L. E. Cary.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-770, 1985. 79p, 1 fig, 29 ref.

Descriptors: *Data collections, *Hydrologic data, *Montana, *Stream gages, *Water quality, *Streamflow, *Surface water, Powder River Basin.

Stations were selected to monitor water discharge and water quality of streams in eastern Montana. This report describes the stations and indicates the availability of hydrologic data through 1985. Included are stations that are operated by organizations that do not belong to the National Water Data Exchange (NAWDEX) program operated by the U.S. Geological Survey. Each station description contains a narration of the station's history including location, drainage area, elevation, operator, period of record, type of equipment and instruments used at the station, and data availability. The data collected at each station have been identified according to type: water discharge, chemical quality, and suspended sediment. Descriptions are provided for 113 stations. These data have potential uses in characterizing small hydrologic basins, as well as other uses. A map of eastern Montana shows the location of the stations selected. (USGS)
W89-04042

SUMMARY OF WATER RESOURCES DATA FOR THE GIRDWOOD-ALYESKA AREA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Glass, and T. P. Brabets.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-678, 1988. 24p, 11 fig, 7 tab, 5 ref.

Descriptors: *Surface water, *Groundwater, *Water quality, *Alaska, Girdwood, Alyeska, Data collections.

Surface water, groundwater and water quality data for the Girdwood-Alyeska area are presented in graphs, tables, and maps. Surface water data include streamflow measurements and water quality analyses from three streams. Groundwater data include descriptions of 106 wells, with lithologic and water quality data from selected wells. The report also contains a map depicting the geology of the area. (USGS)
W89-04046

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NORTH DAKOTA, FISCAL YEAR 1986,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04047

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1987,
Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Map 87-464, 1987. 1 sheet (map).

Descriptors: *Maps, *Potentiometric surface, *Groundwater, *Florida, Hydrologic aspects, Aquifers, St. Johns River Water Management District.

The potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity is shown for May 1987. The Upper Floridan aquifer is the principal source of potable water in the area. Water level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-ft contour intervals. In the Fernandina Beach area of Nassau County, a 30-ft interval is used to show a deep cone of depression. The potentiometric surface ranged from 129 ft above sea level in Polk County to 54 ft below sea level in Nassau County. Water levels in key wells ranged from several ft above to several ft below the May average in response to areal patterns of rainfall. Most levels in the district were above the below average levels of May 1986. Rises of about 2 ft from May 1986 levels were common in the southern half of the District, and the potentiometric surface rose as much as 6 to 8 ft in places. (USGS)
W89-04049

GROUNDWATER LEVELS IN ARKANSAS, SPRING 1987,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04051

STATISTICAL, GRAPHICAL, AND TREND ANALYSES OF SELECTED WATER QUALITY AND STREAMFLOW DATA FROM THE TRINITY RIVER NEAR CROCKETT, TEXAS, 1964-85,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04053

PRELIMINARY DATA FOR NORTHERN GREAT PLAINS TEST WELL 1, NW 1/4 NE 1/4 SEC. 11, T.55N., R.77W., SHERIDAN COUNTY, WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04055

GOES DATA-COLLECTION SYSTEM INSTRUMENTATION, INSTALLATION, AND MAINTENANCE MANUAL,
Geological Survey, Phoenix, AZ. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-04056

APPROXIMATE CHANGE IN WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-87 AND 1986-87, AND MEASURED COMPACTION, 1973-87, IN THE HOUSTON-GALVESTON REGION, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
J. F. Williams.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-108, 1987. 7 sheets (maps), 6 fig.

Descriptors: *Maps, *Groundwater, *Water levels, *Water level fluctuations, *Compaction, *Subsidence, *Texas, Land-surface subsidence, Houston, Compaction monitors.

This report consists of: (1) four maps that present data on water level changes during 1977-87 and 1986-87 in the Chicot and Evangeline aquifers, and in the Houston-Galveston region, Texas, and (2) one set of graphs and one map that present data on land subsidence caused by compaction of sub-surface materials for 1973-87. (USGS)
W89-04057

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1986 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04058

FLOODS IN EASTERN NEBRASKA AND SOUTHEASTERN SOUTH DAKOTA, JUNE 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04059

GENERAL SURFACE AND GROUNDWATER QUALITY IN A COAL-RESOURCE AREA NEAR DURANGO, SOUTHWESTERN COLORADO,
Geological Survey, Grand Junction, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04063

HYDROLOGY OF AREA 41, WESTERN REGION, INTERIOR COAL PROVINCE, OKLAHOMA AND ARKANSAS,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.

W89-04070

GROUNDWATER LEVEL DATA FOR THE ALBUQUERQUE-BELEN BASIN, NEW MEXICO THROUGH WATER YEAR 1985,
Geological Survey, Albuquerque, NM. Water Resources Div.
G. E. Kues.
Available from Books and Open File Report Section, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-116, 1987. 51p, 75 fig, 1 tab, 2 ref.

Descriptors: *Groundwater, *Groundwater level, *Hydrologic data collections, *New Mexico, Water level, Well data, Albuquerque-Belen Basin.

The Albuquerque-Belen Basin is in north-central New Mexico and is approximately 100 mi long and 25 to 40 mi wide. The only perennial stream in the area, the southward-flowing Rio Grande, approximately bisects the basin. Groundwater is the only source used to obtain drinking-water supplies. The basin's population increased more than 100% from 1960 to 1980. In 1980, 72% of the population was concentrated in the north-central part of the basin in and around the city of Albuquerque. Increases in population caused increases in water demand and groundwater pumpage. A network of wells was selected between April 1982 and September 1983 to monitor changes in groundwater levels. (USGS)
W89-04071

GROUNDWATER AVAILABILITY IN THE EASTERN PART OF THE LAKE ONTARIO BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
T. S. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4201, 1987. 2 fig, 5 ref, 3 plates.

Descriptors: *Geology, *Maps, *Groundwater, *Aquifers, *New York, *Lake Ontario Basin, Geohydrology.

A set of three maps show surficial geology, significant unconsolidated aquifers and well yield, and selected well locations for the Lake Ontario basin, New York. In the low areas, glaciers and wave action of former high-level lakes deposited permeable sand and gravel to form aquifers that yield more than 10 gal/min of water to wells. Small quantities of water (less than 2 gal/min) can be pumped from dug wells that top till and fine lake-sediment deposits. (USGS)
W89-04074

GEOHYDROLOGIC DATA FROM PORT ROYAL SOUND, BEAUFORT COUNTY, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04075

SELECTED GROUNDWATER DATA IN THE UPPER MONGAUP RIVER BASIN, SULLIVAN COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-114, 1987. 4 plates, 4 fig, 1 ref.

Descriptors: *Maps, *Groundwater data, *Hydrologic data, *New York, Well data, Well yield, Well logs, Wells, Test holes, Test wells, Springs, Sullivan County, Mongaup River, Delaware River Basin.

A set of four adjoining 7.5-minute quadrangle sheets that together depict the upper Mongaup River Basin in Sullivan County, N.Y., at 1:24,000 scale show the location, well yield, depth, water use, ownership, and date of ownership of wells, test holes, and springs. Most wells that tap stratified-drift deposits have high yields (50 to 300 gal/min) and are used for public supply. Bedrock wells have smaller yields and are generally used for domestic supply. The data were compiled from a previous U.S. Geological Survey, countywide, groundwater resources report and from unpublished data. (USGS)
W89-04077

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1986,
Geological Survey, Jacksonville, FL. Water Resources Div.
R. M. Spechler.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-36, 1987. 1 sheet (map).

Descriptors: *Maps, *Potentiometric surface, *Florida, Groundwater, Hydrologic aspects, Aquifers, Hydrogeology, St. Johns River Water Management District.

This map shows the potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity for September 1986. The Upper Floridan aquifer is the principal source of potable water in the area. Water level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-ft contour intervals. The potentiometric surface ranged from 129 ft above sea level in Polk County to 88 ft below sea level in Nassau County. The steep cone of depression of the potentiometric surface in the Fernandina Beach area of Nassau County is caused by large withdrawal of groundwater for industrial use. Many water levels in the district were equal to or lower than water levels of September 1985. Declines of as much as 2 ft from September 1985 levels were common throughout the district in response to a decline in rainfall and an increase in pumpage. The largest decline from September 1985 potentiometric surface level was 8 ft, occurring in Indian River County. Levels in many wells approached, and in a few wells exceeded, record lows. (USGS)
W89-04080

RECONNAISSANCE OF SURFACE-WATER RESOURCES IN THE KOBUK RIVER BASIN, ALASKA, 1979-80,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04083

METEOROLOGICAL, WATER TEMPERATURE, AND DISCHARGE DATA FOR THE MATTOLE RIVER BASIN, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-04084

PUMPAGE DATA FROM PUBLIC-SUPPLY WELLS AT ANCHORAGE, ALASKA, 1957-85.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-542, 1987. 48p, 48 fig, 47 tab.

Descriptors: *Pumpage data, *Water use, *Water supply, *Alaska, *Anchorage, *Water wells, Data collections, Water use data, Water yield.

Tables of data for each well include monthly and yearly pumpage totals, average monthly pumpage for each year, and monthly (January-December) average pumpage for the period of record. Total monthly pumpage for each well is also portrayed graphically. The data are also accessible on computer files at the U.S. Geological Survey's Alaska District Office in Anchorage. (USGS)
W89-04085

GROUNDWATER LEVELS IN THE CARBONATE ROCKS OF CENTRAL CHESTER COUNTY, PENNSYLVANIA, MAY 18 TO JUNE 15, 1984,
Geological Survey, Harrisburg, PA. Water Resources Div.
C. R. Wood.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-715, 1984. 1 sheet (map), 1 fig.

Descriptors: *Maps, *Water table, *Carbonate rocks, *Karst, *Groundwater data, *Pennsylvania, *Chester county, Water levels, Data collections, Water wells.

A water-table contour map of the carbonate rocks of central Chester Valley in Chester County, Pennsylvania was constructed based on water levels measured in 104 wells in May and June 1984, the altitude of 10 springs, and the level reported in 16 wells and one active quarry. The area of carbonate rock underlies parts of East Whiteland, West Whiteland, East Caln, and Caln Townships, the Borough of Downingtown, an the city of Coatesville. Water-level altitudes in the carbonate rocks range from 396 ft above sea level in the western part of East Whiteland Township to 232 ft in Downingtown Borough. (USGS)
W89-04086

DATA FOR SELECTED PESTICIDES AND VOLATILE ORGANIC COMPOUNDS FOR WELLS IN THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA, FEBRUARY TO JULY 1985,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04087

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1965,
Geological Survey, Garden City, KS. Water Resources Div.
M. E. Pabst, and L. E. Stullken.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-449, 1982. 1 sheet (map), 3 fig, 9 ref.

Descriptors: *Water table, *Potentiometric level, *Underground storage, *Aquifers, *Kansas, *High plains, Groundwater, Unconfined aquifers, Underflow.

The High Plains aquifer in Kansas is a part of a regional system that extends South Dakota to Texas. The aquifer in Kansas underlies an area of 31,000 square miles in the western and south-central part. This aquifer is a hydraulically connected assemblage of unconsolidated water-bearing deposits of Tertiary and Quaternary age. Maps published at a scale of 1:500,000 show the altitude and configuration of the water table in Kansas during 1965. Groundwater moved from higher altitudes in the western part of the High Plains to lower altitudes in the eastern part at a average rate of 10 ft/mi. The upgradient flexure of water table contours along some of the valleys indicates that groundwater was discharged to the streams in those areas. (USGS)
W89-04088

RECORDS OF WELLS AND CHEMICAL ANALYSES OF GROUNDWATER IN CAMPBELL COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04089

SIMULATION OF RAIN FLOODS ON WILLOW CREEK, VALLEY COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04090

SELECTED HYDROLOGIC DATA FOR SALT LAKE VALLEY, UTAH, OCTOBER 1968 TO OCTOBER 1985,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04093

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1983,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. A. Bradner.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-676, 1983. 1 sheet (map).

Descriptors: *Potentiometric level, *Groundwater, *Hydrologic aspects, *Aquifer, *Hydrogeology, *Water levels, *Sumter County, *Florida, Hydrologic data.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for September 1983. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the high water-level period. Water level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 ft in the southeast part of the county to less than 40 ft northwest of Lake Panasoffkee in the west-central area. (USGS)
W89-04094

AREAL AND TEMPORAL VARIABILITY OF WATER QUALITY OF THE SAN JUAN RIVER DRAINAGE BASIN UPSTREAM FROM SHIPROCK, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-04105

HYDROGEOLOGY OF THE VALLEY-FILL AQUIFERS, SALAMANCA AREA, CATTARAGUS COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
P. J. Zarriello.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 85-4149, 1987. 6 sheets (maps), 5 fig, 21 ref.

Descriptors: *Groundwater, *Areal hydrogeology, *Geohydrology, *Maps, *New York, Aquifers, Geologic mapping, Glacial drift, Land use, Groundwater level, Allegheny River valley, Salamanca, Cattaragus County, Surficial geology, Water table, Soil permeability, Land use.

The hydrogeology of a 132-sq mi area centered at Salamanca, NY, is summarized in five maps at 1:24,000 scale. The maps show locations of wells and test holes, surficial geology and geologic sections, water-table surface, soil permeability, and land use. The valley-fill aquifer in the Salamanca area serves approximately 7,000 people through two major distribution systems with an average daily pumpage of 1.2 million gal/day. The aquifer, composed of outwash sand and gravel, averages 60 ft in thickness and overlies as much as 200 ft of lacustrine silt and clay. The aquifer is recharged directly from precipitation and through seepage from streams. Average annual recharge to the aquifer from direct precipitation and infiltration of runoff from adjacent hillsides is estimated to be 13 inches or 0.6 million gal/day/sq mi. The glacial features in the Allegheny valley near Salamanca are associated with Illinoian and Wisconsin glaciations. Illinoian features consist of small, isolated exposures of outwash and till emplaced against the valley walls. Wisconsin features deposited during Altonian and Woodfordian Times of the Wisconsin consist mainly of end moraines and valley-train outwash. (USGS)
W89-04109

DOCUMENTATION OF COMPUTER PROGRAM VS2D TO SOLVE THE EQUATIONS OF FLUID FLOW IN VARIABLY SATURATED POROUS MEDIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04111

FLOODS OF OCTOBER 1986 IN SOUTH-CENTRAL ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04122

HYDROGEOLOGIC DATA FROM A STUDY OF THE FRESHWATER ZONE/SALINE WATER ZONE INTERFACE IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-04123

RAINFALL-RUNOFF DATA FOR SOMERSET COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-04130

FLOODS IN IOWA: STAGE AND DISCHARGE,
Geological Survey, Iowa City, IA. Water Resources Div.
O. G. Lara, and D. A. Eash.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-382, 1987. 793p, 1 tab.

Descriptors: *Floods, *Peak discharge, *Iowa, *Streamflow, *Hydrologic data, Bankfull stage, Flood stages, Data collections.

This report presents stations descriptions and tables of peak stages and discharges for 280 continuous- and partial-record gaging stations in Iowa. Data for the annual flood series for each gaging station and partial-duration series, at stations where available, are contained in the report. (USGS)
W89-04131

GROUNDWATER DATA FOR GEORGIA, 1986,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04132

WATER RESOURCES ACTIVITIES IN FLORIDA, 1986-87,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04134

SELECTED WATER QUALITY DATA FOR THE BURLEY IRRIGATION DISTRICT, SOUTH-CENTRAL IDAHO, MARCH-APRIL 1987,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young, D. J. Parliman, and M. L. Jones.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report (map) 87-240, 1987. 1 sheet (map), 3 fig, 2 tab, 2 ref.

Descriptors: *Maps, *Water quality, *Nitrogen compounds, *Drinking water, *Groundwater contamination, *Idaho, Groundwater level, Nitrates, Snake River Plain, Burley Irrigation District.

This map report presents selected March-April 1987, water quality data, principally dissolved nitrite plus nitrate as nitrogen, and depth-to-water measurements for 118 wells in the Burley Irrigation District, south-central Idaho. Nitrogen concentrations ranged from 0.37 to 30 mg/L; the median concentration was 8.0 mg/L. Nitrogen concentrations in 19 wells equaled or exceeded the U.S. Environmental Protection Agency public drinking water limit of 10 mg/L. (USGS)
W89-04135

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT IN THE 1986 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04137

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1987,
Geological Survey, Houston, TX. Water Resources Div.
J. F. Williams, W. B. Lind, and L. S. C. Coplin.
Available from Books and Open File report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File report 87-233, 1987. 2 sheets (maps), 2 fig, 1 ref.

Descriptors: *Groundwater, *Water-level fluctuations, *Groundwater levels, *Texas, *Maps, Water levels, Houston.

Two maps show water levels in wells in the Houston, Texas, area in the Chicot aquifer, spring 1987, and the Evangeline aquifer, spring 1987. Both the Chicot and Evangeline aquifers are composed of several sand layers with different potentiometric surfaces. These maps, however, show approximations of single potentiometric surfaces that represent composite hydraulic heads. (USGS)
W89-04138

WATER RESOURCES INVESTIGATIONS IN TENNESSEE: PROGRAMS AND ACTIVITIES OF THE U. S. GEOLOGICAL SURVEY, 1986-87,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04139

GROUNDWATER LEVELS IN ALASKA, WATER YEAR 1984,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still, and J. O. Brunett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-230, 1987. 308p, 264 fig.

Descriptors: *Water levels, *Alaska, *Groundwater levels, *Hydrologic data, Data collections, Well data, Observation wells.

Data on groundwater levels in Alaska for the 1984 water yr have been compiled in the second of a planned series of reports. The report summarizes data from a network of observation wells, throughout the State, at which water levels are either recorded continuously or measured intermittently. For wells at which water levels are measured semiannually, 10-yr summaries are presented. Water levels for 222 observation wells are shown on graphs, and locations for the wells are shown on accompanying maps. The following information is given for each well: location, owner, type of aquifer, depth and casing information, type of measure-

ment, altitude datum, period of record, and extremes for the period of record. (USGS)
W89-04140

REVIEW OF THE WATER RESOURCES INFORMATION SYSTEM OF ARGENTINA,
Geological Survey, Reston, VA. Water Resources Div.
N. E. Hutchison.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-226, 1987. 15p, 6 fig, 5 ref, 2 append.

Descriptors: *Computers, *Water resources data, *Information systems, *Argentina, *Hydrologic data, *Data storage and retrieval, Water, Data transmission, Data processing.

A representative of the U.S. Geological Survey traveled to Buenos Aires, Argentina, in November 1986, to discuss water information systems and data bank implementation in the Argentine Government Center for Water Resources Information. Software has been written by Center personnel for a minicomputer to be used to manage inventory (index) data and water quality data. Additional hardware and software have been ordered to upgrade the existing computer. Four microcomputers, statistical and data base management software, and network hardware and software for linking the computers have also been ordered. The Center plans to develop a nationwide distributed data base for Argentina that will include the major regional offices as nodes. Needs for continued development of the water resources information system for Argentina were reviewed. Identified needs include: (1) conducting a requirements analysis to define the content of the data base and insure that all user requirements are met, (2) preparing a plan for the development, implementation, and operation of the data base, and (3) developing a conceptual design to inform all development personnel and users of the basic functionality planned for the system. A quality assurance and configuration management program to provide oversight to the development process was also discussed. (USGS)
W89-04142

RECORDS OF WELLS AND CHEMICAL ANALYSES OF WATER FROM WELLS FOR THE PERIOD JUNE 13, 1984 TO DECEMBER 4, 1986 AT THE MAXEY FLATS RADIOACTIVE WASTE DISPOSAL SITE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-04144

ANNUAL PEAK DISCHARGES AND STAGES THROUGH 1984 FOR GAGING STATIONS IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
B. L. Neely.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-208, 1987. 125p, 1 fig, 1 tab, 6 ref.

Descriptors: *Flood peak, *Flood stages, *Arkansas, *Missouri, *Flood discharge, *Louisiana, *Oklahoma, Drainage area, Flood data, Hydrologic data, Data collections.

Annual peak discharges and stages at 254 gaging stations, which are the basic data supporting the U.S. Geological Survey report 'Magnitude and Frequency of Floods in Arkansas,' are presented. These data include the peak discharge and stage for each yr and the date of occurrence, location of gaging station, description of gage, and supplemental remarks. These data are from gaging stations which have at least 10 yr of record. A map of the area shows the location of the data collection gaging stations. (USGS)
W89-04145

STREAMFLOW AND CROSS-SECTION DATA FOR TOMBIGBEE RIVER BETWEEN GAINESVILLE AND DEMOPOLIS LOCKS AND DAMS,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04146

AVAILABILITY OF STREAMFLOW DATA FOR THE MOBILE RIVER AND ITS DISTRIBUTARIES INCLUDING THE LOWER ALABAMA RIVER AND LOWER TOMBIGBEE RIVER,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04147

STREAMFLOW AND CROSS-SECTION DATA FOR TOMBIGBEE RIVER BETWEEN ALICEVILLE AND GAINESVILLE LOCKS AND DAMS,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04148

ACTIVITIES OF THE ALASKA DISTRICT, WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, 1987,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 9C.
W89-04150

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1985,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2B.
W89-04151

WATER USE DATA COLLECTION PROGRAMS AND REGIONAL DATA BASE OF THE GREAT LAKES-ST. LAWRENCE RIVER BASIN STATES AND PROVINCES,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-04154

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN THE TUCSON BASIN, PIMA COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
S. R. Anderson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-482, 1986. 3 sheets, 9 fig, 48 ref.

Descriptors: *Subsidence, *Geohydrology, *Water table decline, *Arizona, Extensometers, Alluvial aquifers, Groundwater pumpage, Groundwater depletion, Pima County, Tucson basin.

In 1979 the U.S. Geological Survey, in cooperation with the city of Tucson, began an investigation of aquifer compaction and its effects in the Tucson basin, including the potential hazards of aquifer compaction and subsequent damage to engineered structures, roads, water supply systems, gaslines, and sewage systems. Groundwater is the main source of water for irrigation, public supply, and industry. Pumping has exceeded recharge for several decades, and declines in groundwater levels have occurred in parts of the basin. In places, water level declines have resulted in small amounts of aquifer compaction and land subsidence. Further water level declines in parts of the Tucson basin may result in large amounts of aquifer compaction and land subsidence. Differential land subsidence may, in places, be accompanied by the formation of earth fissures. Aquifer compaction, land subsidence, and earth fissures can damage or affect the functional capability of manmade features. Specifically, aquifer compaction may damage wells, fissures may damage engineered structures, and differential land subsidence may affect structures such as sewers and water-supply systems that are dependent on gravity for their operation. (USGS)
W89-04156

GROUNDWATER DATA FOR WEST VIRGINIA, 1974-84,
Geological Survey, Morgantown, WV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04157

STREAMFLOW CHARACTERISTICS OF THE COLORADO RIVER BASIN IN UTAH THROUGH SEPTEMBER 1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-04160

HYDROLOGIC DATA FROM THE INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS, NEW YORK - OCTOBER 1977 THROUGH JANUARY 1982,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-04161

USER'S MANUAL FOR ESTIMATION OF DISSOLVED-SOLIDS CONCENTRATIONS AND LOADS IN SURFACE WATER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-04172

GROUNDWATER LEVELS IN THE LOWER PALEOZOIC AND PRECAMBRIAN CRYSTALLINE ROCKS OF SOUTHEASTERN CHESTER COUNTY, PENNSYLVANIA, JULY AND AUGUST 1986,
Geological Survey, Harrisburg, PA. Water Resources Div.
J. A. Garges.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4352, 1986.

Descriptors: *Water table, *Maps, *Aquifers, *Groundwater data, *Pennsylvania, Crystalline rocks, Data collections, Hydrologic data, Chester County.

A water table contour map of the lower Paleozoic and Precambrian crystalline rocks of southeastern Chester County, Pennsylvania was constructed on the basis of water levels measured in 261 wells in July and August 1986, elevations of 11 springs that were flowing in July and August 1986, and water levels measured in 15 wells. Pre-1986 measurements were incorporated on the map to provide control in areas where more-recent data were not available. The area of crystalline rocks underlies Thornbury, Westtown, East Goshen, and West Goshen Townships, parts of East Whiteland and West Whiteland Townships; and West Chester Borough. Water table altitudes under natural conditions range from 544 ft. above National Geodetic Vertical Datum of 1929 (NGVD of 1929) near Immaculata College to 234 ft. above NGVD of 1929 near Cheyney College. (USGS)
W89-04174

WATER QUALITY ASSESSMENT OF PERUQUE CREEK, ST. CHARLES COUNTY, MISSOURI, JULY 1983 AND JULY 1984,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.

W89-04176

GEOLOGY AND HYDROLOGY OF DEEP BEDROCK AQUIFERS IN EASTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04179

MACDRAIN: A SURVEYING, MAPPING, AND DRAINAGE DESIGN SYSTEM FOR THE MICROCOMPUTER,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
R. Kok, and S. Tremblay.
Canadian Agricultural Engineering CAEOAI, Vol. 30, No. 2, p 195-203, July 1988. 4 fig, 20 ref.

Descriptors: *MACDRAIN, *Drainage design, *Computer programs, Mapping, Surveys, Data processing, Computer-aided-design, Agricultural hydrology, Hydraulic conductivity, Topography.

A software package called MACDRAIN was written for use on IBM PC-type microcomputers. It is an integrated set of programs that can be used to process survey data into topographic and contour maps, process auger hole data into hydraulic conductivities, calculate drain spacings, design drainage systems, archive data, and produce high quality maps, drain plans, and profile views. MACDRAIN has been developed to the point where it can be used for professional design of drainage systems under most circumstances, but regularly-shaped fields of moderate slope are more easily dealt with than those exhibiting extremes in form or surface irregularity. Since the package is a design tool rather than a replacement for the designer, effective use requires that the user have prior knowledge of drainage system design. Learning times for system use (to a level of proficiency from which the user can proceed independently to 'expert' capability) can range from several hours to a week. (Rochester-PTT)
W89-04214

UNCERTAINTY ESTIMATES FOR SURFACE RUNOFF MODELS,
Williamson and Schmid, Irvine, CA.
For primary bibliographic entry see Field 2E.
W89-04240

FINITE ELEMENT MODELLING OF RECIRCULATING DENSITY-DRIVEN SALTWATER INTRUSION PROCESSES IN GROUNDWATER,
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Matematik und Mechanik.
For primary bibliographic entry see Field 2F.
W89-04243

HYDROGEOLOGY AND AQUIFER SIMULATION OF THE BASEMENT ROCKS OF THE KADUNA-ZAIRIA AREA, NORTHERN NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Geology.
For primary bibliographic entry see Field 4B.
W89-04244

ORGANIC MATTER DYNAMICS IN FOUR SEASONALLY FLOODED FOREST COMMUNITIES OF THE DISMAL SWAMP,
Savannah River Ecology Lab., Aiken, SC. Div. of Wetlands Ecology.
For primary bibliographic entry see Field 2H.
W89-04245

IMPROVING IRRIGATION MANAGEMENT BY MODELLING THE IRRIGATION SCHEDULE,
Katholieke Univ. Leuven (Belgium). Soil and Water Engineering Lab.
P. Van Aelst, R. A. Ragab, J. Feyen, and D. Raes.
Agricultural Water Management AWMADF, Vol, 13, No. 2-4, p 113-125, June 1988. 7 fig, 3 tab, 13 ref.

Descriptors: *Irrigation practices, *Hydrological models, *Irrigation programs, Transpiration control, Water table fluctuations, Egypt, corn, Hydrologic budget, Moisture profiles, Simulation analysis, Capillarity.

Three different treatments of corn, grown on three field plots in the Nile delta in Egypt have been evaluated using the simulation model SWATRE. With this field water balance model the ingoing and outgoing water fluxes, the soil moisture profile and the water-table depth of the three irrigation treatments monitored were simulated daily throughout the 1983 growing season. For validation the simulated water-table depths were compared to the observed water-table fluctuation. The validated field water balanced model was then used to evaluate a number of hypothetical irrigation schedules in order to improve the actual irrigation practice. The simulation runs indicated that the water-table contribution through capillary rise varies between 25 and 30% of the actual crop water consumption, and that this amount is barely affected by the screened irrigation schedules. In addition it was found that plant transpiration and yield respond accurately to modifications in the irrigation timing applied. (Author's abstract)
W89-04257

NON-DIMENSIONAL DIAGRAMS FOR UNSTEADY DRAINAGE PROBLEMS WITH OR WITHOUT RECHARGE,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
For primary bibliographic entry see Field 2F.
W89-04259

EVALUATION OF VARIOUS COMPUTATIONAL SCHEMES IN CALCULATING UNSATURATED HYDRAULIC CONDUCTIVITY,
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
For primary bibliographic entry see Field 2G.
W89-04273

SIMULATION OF SURFACE-MOISTURE EFFECTS ON THE GREAT PLAINS LOW-LEVEL JET,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-04283

FRACTAL CHARACTERIZATION OF INTERTROPICAL PRECIPITATIONS VARIABILITY AND ANISOTROPY (CARACTERISATION FRACTALE DE LA VARIABILITE ET DE L'ANISOTROPIE DES PRECIPITATIONS INTERTROPICALES),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2B.
W89-04293

MONTHLY HYDROGEN ION DEPOSITION MAPS FOR THE NORTHEASTERN U.S. FROM JULY 1982 TO SEPTEMBER 1984,
Consolidation Coal Co., Pittsburgh, PA.
For primary bibliographic entry see Field 5B.
W89-04300

USE OF KRIGING IN THE SPATIAL ANALYSIS OF ACID PRECIPITATION DATA,
ERT, Inc., Camarillo, CA.
A. Venkatram.
Atmospheric Environment ATENBP, Vol. 22, No. 9, p 1963-1975, September 1988. 7 fig, 2 tab, 14 ref.

Descriptors: *Precipitation, *Rainfall, *Acid rain, *Model studies, *Kriging, Deterministic models, Spatial analysis, Kriging, Sulfur.

A technique known as simple kriging that is becoming popular in the spatial analysis of data pertinent to acid rain is examined. A detailed derivation of the relevant equations in order to clarify the assumptions that underlie the technique is provided. A major assumption is that a given set of observations can be represented as the sum of a constant mean and a stochastic fluctuation, which is governed by an isotropic and homogeneous spatial autocorrelation function. Because this assumption cannot be justified in the context of precipitation chemistry data that reflect inhomogeneous processes, a technique that combines deterministic modeling with the attractive features of kriging is suggested. This technique is demonstrated by applying it to a data set consisting of annual averages of wet deposition of sulfur. Simple kriging explains 36% of the variance of the observed values of wet deposition; the corresponding figure resulting from the use of the statistical model is 55%, which supports the contention that spatial analysis by simple kriging can be improved through the incorporation of deterministic models. (Author's abstract)
W89-04301

SIMULATION OF THE AQUATIC FATE OF TRICLOPYR BUTOXYETHYL ESTER AND ITS PREDICTED EFFECTS ON COHO SALMON,
Dow Chemical Co., Midland, MI. Agricultural Products Dept.
For primary bibliographic entry see Field 5B.
W89-04326

USING STREAM SURVEY DATA TO PREDICT DIRECTIONAL CHANGE IN FISH POPULATIONS FOLLOWING PHYSICOCHEMICAL STREAM PERTURBATIONS,
Kansas Dept. of Wildlife and Parks, Pratt. Environmental Services Section.
For primary bibliographic entry see Field 5C.
W89-04336

PROPOSED METHOD FOR CALCULATING TAXONOMIC-GROUP-SPECIFIC VARIANCES FOR USE IN ECOLOGICAL RISK ASSESSMENT,
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W89-04355

TIME-MARCHING APPROACH FOR PIPE STEADY FLOWS,
National Research Inst. of Agricultural Engineering, Yatabe (Japan). Dept. of Hydrological Engineering.
For primary bibliographic entry see Field 8B.
W89-04358

COMPUTER-AIDED DESIGN FOR CHANNELIZATION,
San Diego State Univ., CA. Dept. of Chemistry.
For primary bibliographic entry see Field 8B.
W89-04362

GROUNDWATER QUALITY: A DATA ANALYSIS PROTOCOL,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5A.
W89-04368

KYERMO - A PHYSICALLY BASED RESEARCH EROSION MODEL: PART I. MODEL DEVELOPMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W89-04384

CASE STUDY OF URBAN RUNOFF POLLUTION: 1. DATA COLLECTION, RUNOFF QUALITY, AND LOADS,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.

For primary bibliographic entry see Field 5B.
W89-04394

DEVELOPMENT OF AN ENVIRONMENTAL SENSITIVITY INDEX FOR COASTAL AREAS OF LAKE ERIE, NORTH AMERICA,
Ohio State Univ., Columbus. Franz Theodore Stone Lab.
For primary bibliographic entry see Field 2H.
W89-04517

MULTIVARIATE APPROACH FOR EVALUATING RESPONSES OF FISH TO CHRONIC POLLUTANT STRESS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-04554

8. ENGINEERING WORKS

8A. Structures

WAX LAKE OUTLET CONTROL STRUCTURE, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. A. Davidson.
Available from the National Technical Information Service, Springfield, VA 22161as AD-A199 971. Price codes A03 in paper copy, A01 in microfiche. Technical Report HL-88-23, September 1988. Final Report. 46p, 3 fig, 7 photos, 24 plates.

Descriptors: *Lakes, *Hydraulic structures, *Wax Lake, *Outlet channels, *Louisiana, *Hydraulic models, *Flow control, Riprap, Channels, Model studies, Slope stabilization.

The Wax Lake Outlet Channel is an artificial channel that diverts 30% of the flow from the Atchafalaya River to the Gulf of Mexico. Because of degradation of the channel, its capacity to carry flow during nonflood periods has increased, resulting in lower river stages at Morgan City, Louisiana. A stone control structure was proposed to control the amount of flow passing through the Wax Lake Outlet Channel. Tests were conducted on a 1:30-scale model that initially reproduced one-half of the rock weir notch (425 ft) and a 785-ft-long portion of the overflow rock weir at elevation 7.5 ft referred to the National Geodetic Vertical Datum. Discharge coefficients were obtained for free-flow and submerged-flow conditions for both the overflow weir and notch. Riprap stability tests in the notch indicated that type C riprap (D sub 50 minimum = 2.31 ft) would remain stable on the downstream slope if the slope was changed from a 1V on 4H to 1V on 10H. Riprap stability tests for the overflow section indicated that a type B (D sub 50 minimum = 2.05) gradation would remain stable for anticipated flows. (Author's abstract)
W89-03364

OVERVIEW OF ALTERNATIVE SEWER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. F. Kreissl.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-185624. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/054, March 1988. 11p, 11 ref.

Descriptors: *Sewer systems, *Sewers, *Design standards, Sewer hydraulics, Gravity sewer, Pressure sewer, Vacuum sewer, Costs, Maintenance.

Three basic types of alternative collection systems are discussed -- pressure, vacuum and small-diameter gravity (SDG) sewers. Their descriptions and histories of use are provided. Comparisons are made on the basis of design, practical application, operation and maintenance, and cost. Although there remains a need to fully quantify long-term operation, maintenance and performance characteristics, the apparent economic advantages of these systems are sufficient to have caused widespread adoption in rural communities. (Lantz-PTT)
W89-03365

LEAKPROOFING AN RCC DAM,
Freese and Nichols, Inc., Fort Worth, TX.
R. M. Lemons.
Civil Engineering CEWRA9, Vol. 58, No. 10, p 58-60, October 1988. 1 fig.

Descriptors: *Reinforced concrete, *Leakage, *Concrete dams, Dam design, Dam construction, Texas, Spillways, Design criteria, Cost analysis.

To stop leakage on the Stacy Dam, a roller compacted concrete (RCC) dam being constructed in west central Texas, the spillway is being faced with reinforced concrete. The facing will be attached by anchors cast into the RCC. To pass floods, the dam has a service spillway in the left abutment and a 6,000 ft long emergency spillway in the right abutment. To prevent seepage through the weathered rock under the dam, a core trench was excavated through the overburden and weathered limestone along the full length. The outlet works, located between the river channel and the service spillway, will piggyback 72 inch and 12 inch discharge conduits through the dam. Control gates are near the centerline and the 12 inch conduit will also have a valve at the downstream end to allow greater control over releases. A drainage tunnel was placed under the service spillway so that the clay-shale layers in the limestone foundation could be drained, preventing loss of strength with saturation. The service spillway is founded on the Belle Plains formation which contains a small amount of salty pore water that precludes the use of rock anchors under the crest and along the spillway chute. Since rock anchors could not be used, the shale beds had to be replaced with gravity sections. Based on cost studies, it was decided that a reinforced concrete upstream facing, placed after RCC completion, would be an economical means of preventing leakage. To reduce cracking due to excessive temperature gradient across the RCC, the facing will not be placed until after the RCC begins to cool. RCC is also used in the chute training walls where it will be subjected to very high velocity, turbulent flow. To prevent possible damage, the walls will be faced with concrete similar to the facing on the gravity section. Total cost of the dam is $30,738,761. (Geiger-PTT)
W89-03491

ENVIRONMENTAL EFFECTS OF THE HIGH DAM AT ASWAN,
Colorado Univ., Boulder. Inst. of Behavioral Science.
For primary bibliographic entry see Field 6G.
W89-03538

KONTAGORA DAM: ASPECTS OF DESIGN AND CONSTRUCTION OF AN EMBANKMENT DAM RELEVANT TO A REMOTE RURAL AREA OF WEST AFRICA,
N. S. M. Berry, J. P. Millmore, A. Smith, and J. W. Findlay.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, p 855-874, October 1988. 10 fig, 2 tab, 4 ref, append.

Descriptors: *Dam design, *Dam construction, *Nigeria, Reservoirs, Rural areas, Site selection, Feasibility studies, Decision making, Design criteria.

Kontagora Dam, a major impounding reservoir in a remote rural area of Nigeria, was developed from initial proposal to completion in a little over two years. This included recognition of the basic need and consideration of alternative schemes, in addition to the feasibility study and geotechnical investigation of the chosen site. Some of the decision making processes used in the design and programming of a relatively large project scheduled for rapid completion are described. The particular problems brought about by the remoteness of the area, including limited hydrological data, logistical support and a delivery of materials are examined. Focus is made on the effects of local conditions and insights into the most relevant factors now known to apply to such work. Considerable attention is paid to the organization of the temporary works devised to cope with a seasonal river capable of flash flooding in the wet season, including an actual event during construction where the flow rose from 1 to 120 cu m/sec in four hours. (Author's abstract)
W89-03932

ISANLU DAM, NIGERIA,
For primary bibliographic entry see Field 8D.
W89-03933

INDUSTRIAL DESIGN OF AN EARTH OVERFLOW DAM,
Y. P. Pravdivets.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 685-689, June 1988. 2 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 15-18, December 1987.

Descriptors: *Dam design, *Earth dams, *Hydraulic structures, *Soviet Union, *Spillways, Slopes, Reinforced concrete, Cost analysis, Revetments, Soil mechanics.

Design considerations for earth overflow dams are discussed based on Soviet experience over the last 10 yr. In design the earth overflow dam represents a trapezoidal body of cohesive or noncohesive soil with a reinforced-concrete spillway sill on the crest, with a protective revetment of precast wedge-shaped or flat stepped-placed elements on the downstream slope, and with an end section in the form of a bucket. The head wall of the spillway part of the dam, as a rule, is made of in situ or precast-in situ reinforced concrete. In this case the best design is a low spillway sill of flat, polygonal, or circular outline. The spillway part is linked with the nonoverflow parts of the earth dam by means of side slopes (sill without piers) or abutments. The spillway slope (face) of the earth dam should smoothly join the spillway sill in the upper part and the bucket (basin) in the lower part. The slope of the bottom of the face depends on the strength and shear characteristics of the dam and filter drainage underlying the revetment. It can be constant or variable over the length. The bucket, as a rule, is made on a rock foundation and is constructed of in situ concrete or is assembled from reinforced-concrete elements of a stone-filled crib. The described design of an earth overflow dam has been employed on a number of projects in the Moscow region and elsewhere in the Soviet Union. Total discharge reaches 2500 cu m/sec on one project. In all cases, the degree of prefabrication of the structure exceeded 60% and the consumption of reinforced concrete was reduced by half and labor expenditures by 3-4 times. (Rochester-PTT)
W89-04182

SEEPAGE STRENGTH OF GYPSINATE FOUNDATIONS OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8D.
W89-04183

DAMMING OF THE VILYUI RIVER CHANNEL AT THE CONSTRUCTION SITE OF THE VILYUI III HYDROELECTRIC STATION,
V. S. Panteleev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 692-697, June 1988. 6 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 19-23, December 1987.

Descriptors: *Vilyui River, *Hydroelectric plants, *Dam construction, *Dam design, *Hydraulic structures, *Soviet Union, Ice jams, Cofferdams, Diversion channels, Flow velocity, River flow, Design criteria, Construction methods.

The Vilyui River originates on the eastern slope of the Anaon Mountains in the central part of the Middle Siberian plateau at a height of 920 m and empties into the Lena River. The length of the

Vilyui River is 2650 km, the drainage area is 45,000 sq km. The annual distribution of runoff of the Vilyui River is not uniform. About 60% of the total runoff passes during the spring flood and about 35% in the summer-fall period. The winter runoff is 4-6% of annual. An ice cover forms in early November, and ice jams develop, leading to a 2-3 m rise in water level. The ice period lasts 156-177 days. The width of the river channel at the site contracted by the cofferdam was 140-143 m, with a maximum water depth of 5-6 m. The design discharge of 10% probability for the period of damming was assumed to equal 1000 cu m/sec. The design called for damming to be carried out by dumping banks at the site of the upstream and downstream cofferdams. Because a large diversion channel was employed, it was possible to construct the dam with local materials at a discharge of 400 cu m/sec during the procedure. The maximum surface velocities during the period of damming were 3.0-3.6 m/sec, the discharge varied from 372 to 403 cu m/sec, and the final difference of levels between the upper and lower pools of the damming site was 0.7 m. (Rochester-PTT)
W89-04184

INCREASE OF THE RELIABILITY AND COST EFFECTIVENESS OF THE LENINGRAD RIVER FLOOD CONTROL GATES,
For primary bibliographic entry see Field 8C.
W89-04186

HYDRAULIC TESTS OF THE SPILLWAY OF THE ZEYA HYDROELECTRIC STATION,
V. M. Boyarskii, V. V. Vasilevskii, M. V. Ginzburg, N. F. Kozodoi, and A. M. Shvainshtein.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 705-710, June 1988. 4 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 33-37, December 1987.

Descriptors: *Hydroelectric plants, *Spillways, *Deterioration, *Hydraulic structures, *Hydraulics, Zeya Hydroelectric Station, Concrete construction, Construction methods, Flow discharge, On-site tests, Floods, Cavitation, Buttress dams, Soviet Union.

The 113-m-high buttress dam of the Zeya Hydroelectric Station (Soviet Union) consists of 41 sections, of which 12 are spillways. The spillway has 12-m-wide bays separated by 3-m-thick walls. The maximum head at the crest is 13.1 m. The capacity of the spillway is up to 9500 cu m/sec during passage of a flood of 0.01% probability. Special care was taken in concrete mixing and construction techniques to develop high cavitation resistance in the spillway surface. Spillways were tested immediately after an inspection to determine the condition of the concrete surfaces. Damage of four different kinds was noted as a result of spillway testing: spalling off of the concrete; dents from the impact of logs; pits formed on the surface of the in situ concrete; and cavitation damage of the concrete surface. The most substantial damage occurred behind the niches of the drain pipes. There was no damage to the concrete after 3.5 hr of operation, but after 15 hr considerable erosion with a depth of 12-20 cm and areas of up to 0.5 sq m was apparent behind the drain pipe niches. The zone of erosion was 20-40 cm from the downstream edge of the niche. The current methods of placing concrete in spillway surfaces do not completely eliminate the formation of cracks and asperities, which leads to cavitation. With duration of releasing discharges of about 65 hr, it was not possible to establish a substantial difference of resistance to cavitation erosion between ski jumps of an in situ and precast concrete design. Future design of spillways should avoid the use of structural elements that disturb the flow (e.g., niches of drain pipes, breaks in the surface) leading to cavitation. (Rochester-PTT)
W89-04187

IMPROVEMENT OF THE METHOD OF CALCULATING THE STRENGTH OF REINFORCED-CONCRETE ELEMENTS ON THE BASIS OF INCLINED SECTIONS,
For primary bibliographic entry see Field 8F.
W89-04189

CURRENT TRENDS IN THE DEVELOPMENT OF PUMPED-STORAGE STATIONS IN THE WORLD,
For primary bibliographic entry see Field 8C.
W89-04190

EXPERIENCE IN CONSTRUCTING THE GRAVITY ARCH DAM OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
K. K. Kuz'min.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 1-5, July 1988. 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 8-11, January 1988.

Descriptors: *Construction methods, *Dam construction, *Arch dams, *Gravity dams, *Soviet Union, *Hydraulic structures, *Hydroelectric plants, Concrete dams, Sayano-Shushenskoe Hydroelectric Station, Costs, Economic aspects, Compressive stress, Deterioration, Tensile stress, Floods, Stilling basins, Design criteria, Spillways, Strength, Hydroelectric plants.

The gravity arch dam of the Sayano-Shushenskoe Hydroelectric Station (Soviet Union) has a construction height of 242.5 m, base width of 107.2 m, crest length of 1066 m, maximum head 220 m, and volume of concrete 8.5 million cu m. The dam forms a reservoir with a total storage of 31 cu km and useful storage of 15 cu km at a normal runoff of 46 cu km. The are 10 mixed-flow turbine units (runner diameter 7 m) in the hydroelectric station, each with a capacity of 640,000 kW. The power plant went into operation before the dam was completed, thus returning to the government all the expenditures on construction. Two major areas were dealt with poorly during construction, diversion of the flow, which in 1979 created an emergency situation, and the use of a stilling basin below to spillway to dissipate energy. Several recommendations for improvement are made that could applied to very large dams constructed in the future. These cover the following: the profile of the dam allows tensile stresses on the upstream face and compressive stresses on the downstream face that may be excessively large; the work of the structure was not taken into account, so that unnecessary structural support was installed for the spillway piers; excessive concern about cracks observed in the dam raised fears about its strength that were later shown to be unjustified; and the architectural appearance of the dam is excessively divided up by the pipelines and piers of the spillway. (Rochester-PTT)
W89-04191

REDUCTION OF THE DAMAGEABILITY OF WATERTIGHT POLYMER-FILM SKINS OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8G.
W89-04193

CONSIDERATION OF METEOROLOGICAL FACTORS WHEN CALCULATING LARGE CANALS,
For primary bibliographic entry see Field 8B.
W89-04198

CONCRETE DAM OF THE BRATSK HYDROELECTRIC STATION,
Z. I. Solov eva.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 50-58, July 1988. 6 fig, 3 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 40-46, January 1988.

Descriptors: *Hydroelectric plants, *Dam foundations, *Mechanical failure, *Concrete dams, *Gravity dams, *Soviet Union, Bratsk Dam, Monitoring, Seepage, Leaching, Decompression, Foundation failure, Construction joints, Design criteria, Trap rocks, Deterioration, Temperature.

The Bratsk (Soviet Union) concrete dam is a gravity dam with expansion joints, with a slope of the downstream face of 1:0.8, on a rock foundation composed of dense, poorly permeable trap rocks. The monitoring and measuring equipment at this dam are described, and data are presented on the settlement, horizontal displacements, internal temperature regime, stress state, cracking in the concrete, seepage and leaching of the concrete, and deformations at the foundation of this dam. The Bratsk dam was designed with sufficient reliability. Settlement of the dam and powerhouse developed uniformly under the entire foundation. Seepage through the concrete and foundation is negligible. Two irreversible processes causing aging of the dam have been established: leaching of the concrete and decompression of the contact zone of the foundation near the upstream face of the dam. Decompression of the rock in the foundation occurs because the powerhouse sections are lighter than the spillway sections and have a less developed base. The zone of decompression is developing in time and in space. The process can be slowed by the combined use of grouting and drainage unloading, which requires further study. (Rochester-PTT)
W89-04200

FORTY YEARS OF OPERATION OF THE HYDRAULIC STRUCTURES OF THE SHIROKOVO HYDROELECTRIC STATION,
M. G. Medvedev.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 59-64, July 1988. 2 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 47-50, January 1988.

Descriptors: *Hydraulic structures, *Hydroelectric plants, *Dam stability, *Rockfill dams, *Spillways, *Soviet Union, Shirokovo Hydrostation, Deterioration, Dam construction, Deformation, Dam design, Grouting, Maintenance, History, Kos'va River.

The Shirokovo hydrostation on the Kos'va River (Northern Urals, Soviet Union) was constructed during the Second World War, when shortages of construction materials required designs with minimal safety factors in order to save materials. The reservoir has and area of 40 sq km and a storage capacity of 526 million cu m (useful = 325 million cu m); in a normal year the production of electricity is 130 million kWh, with an average daily capacity in dry years of 6500 kW. The installed capacity of the two units is 28 MW. The 275-m-long rockfill dam has a height of 40 m and a crest width of 5 m and width at the base of 81.5 m. The slope of the upstream face is 1:0.7 and of the downstream face 1:1.1-1:1.3; berms with a width of 2 m are present at every 6 m over the height. A reinforced-concrete spillway is used. For the most part the structures are operating normally. The rockfill dam has required major work. During almost 30 yr of operation a continuous increase was observed in settlement and horizontal displacement in the central part of the dam. In 1966 in the central part of the dam and in 1967 in the zone adjoining the spillway, a marked increase in the rate of settlement and displacement was noted. Infilling of the central part of the dam with sand and grouting of the zone adjoining the spillway began in 1971 and was mainly completed in 1976. During the period 1973-1979 the increases in settlement and horizontal displacement of the dam crest exceeded 100 mm. During the period 1979-1986, however, the increase in settlement did not exceed 20 mm and horizontal displacement 15 mm. Since 1980, settlement and displacement have been completely absent in the zone of contact between the dam and the spillway abutment. Internal deformations of the dam during 1979-1986 (horizontally and vertically) decreased to 1-1.5 mm/yr. (Rochester-PTT)
W89-04201

CONCERNING THE TECHNOLOGY OF CONSTRUCTING PUMPED-STORAGE STATIONS OF A NEW DESIGN,
B. I. Bolyachevskii.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 65-68, July 1988. 2 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 51-53, January 1988.

Descriptors: *Pumped storage, *Underground powerplants, *Construction methods, *Structures, *Hydraulic design, Hydroelectric power, Soviet Union, Standards, Tunneling, Excavation, Drop shafts, Jack-cable systems.

It was recently proposed that a shaft-type pumped storage station be constructed using concentric cylinders, with the pump-turbine-motor-generator set located in the inner cylinder. The drop shaft method was proposed for making the outside cylinder. The methods of sinking underground structures under their own weight recommended by the Soviet building code and those traditionally used (as well as recommendations for eliminating tilting and sticking) are inadequate. Reliable control of the process of sinking drop shafts can be accomplished by using the external active forces (appropriately adjusted, by using a jack-cable system with simultaneous control of the stress-strain state of the drop shaft--i.e., stresses in the concrete, reinforcement, pressure under the cutting curb, skin friction of the curb. Construction of deep underground structures should be carried out in two or more stages using a reliably-controlled jack-cable sinking system. (Rochester-PTT)
W89-04202

ENGINEERING PROTECTION OF RESERVOIRS OF HYDROPOWER DEVELOPMENTS FROM FLOODING AND SUBIRRIGATION,
For primary bibliographic entry see Field 5G.
W89-04223

REDUCTION OF LOCAL SCOUR AT WING DAMS OF BRIDGE CROSSINGS,
A. A. Kurganovich, and O. N. Klimov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 604-611, April 1988. 13 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 29-33, October 1987.

Descriptors: *Bridge design, *Bridge construction, *Erosion control, *Scour, Water currents, Flow characteristics, Flow around objects, Sediment erosion, Dam design, Dam construction, Design criteria, Construction materials, Construction methods.

Control of local scour at bridge crossings is an urgent problem because of the increased volume of transportation construction and more stringent economic, reliability, and longevity requirements for transportation structures. Local scour at wing dams is caused mainly by secondary transverse currents resulting from the curved flow path past the dam. To alleviate this, rigid guide ribs located on the dam body at an acute angle to the bottom of the flow were designed. A method is proposed for designing these ribs on bridge wing dams which also allows calculating their dimensions for dams of any type with the guaranteed effect of reducing local scour by a factor of 1.5. The box arrangement of the ribs substantially reduces the proportion of nonstandard materials during construction, thereby increasing construction efficiency. The size of the ribbed box makes it possible to reduce structural volume by a factor of at least 8. This design can be used for protecting both existing wing dams and those under construction, thereby producing a considerable cost saving. The method can be adapted for designing erosion-reducing structures at concave banks and also erosion-increasing structures for controlling sediment deposition. This design is considerably more efficient than those proposed earlier and its widespread introduction in hydrotechnical construction practice can be recommended. (Shidler-PTT)
W89-04226

INCREASE OF THE EFFECTIVENESS OF HYDROPOWER CONSTRUCTION EXEMPLIFIED BY THE BLAST-FILL DAMS OF THE KAMBARATA HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 8H.
W89-04227

COMBINED CONSTRUCTION METHOD,
B. M. Shkundin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 619-622, April 1988. 3 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 38-39, October 1987.

Descriptors: *Construction methods, *Excavation, *Hydraulic-fill dams, Earthworks, Hydroelectric plants, Hydraulic machinery, Hydraulic fill, Dredging, Sand, Gravel, Project planning.

The increasing use of massive earthworks in hydropower construction make it expedient to use hydraulic excavation methods, with their inherent technical and economic advantages. However, when excavating heavy soils, particularly gravel, pebble, and boulder soils containing inclusions too large for dredge pumps, their effectiveness drops markedly and their use often becomes impossible. The so-called 'combined method', in which soil is dug by a dry-excavation method and transported to the slurry preparation plant where it is slurried either by excavation by hydraulic monitor, in a sluice feeder or rock chute, or in a mobile hopper with a mixer. The slurry is then hydraulically transported by sluice feeder or rock chute, dredge pump or gravity flow. The combined method is the most effective in many cases, because it has a multitude of modifications and is thus expedient under various conditions. This method also makes it possible to transport soil to individual sites by the dry method and to include sorting equipment and, if necessary, crushing devices in the technological chain. The combined construction method can also be effectively included in the technology of excavating and processing sand, gravel, and other useful materials. When selecting an optimal scheme for constructing earthworks with volumes exceeding 800,000 cubic m, it is recommended that the use of the combined method be considered. This is especially important when the difficulty of excavating with dredges or hydraulic monitors results in the rejection of hydraulic methods. (Shidler-PTT)
W89-04228

PREVENTION OF THE DESTRUCTION OF THE STILLING BASIN OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
P. R. Khlopenkov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 622-625, April 1988. 2 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 43-45, October 1987.

Descriptors: *Hydraulic design, *Spillways, *Stilling basins, *Flood damage, *Hydroelectric plants, *Soviet Union, Design criteria, Flow control, Pressure head, Flow discharge, Hydraulic jump, Hydraulic geometry.

After its very first, and not particularly large, flood the bottom part of the stilling basin of the Sayano-Shushenskow hydrostation was in a disastrous state--the 3-m thick reinforced-concrete slabs of the facing anchored into the rock were destroyed and the foundation rocks were torn out from the bed of the basin by the flow. A search was initiated for a fundamentally-new spillway design, a design which would markedly reduce the force of the flow on the basin revetment without decreasing the head and discharge intensity of the flow along the front of the spillways. Consequently, it was redesigned so that the flow is divided into three compact jets in the lower part of the spillway face of the dam, so that in the zone of descent they are in three layers with free surfaces. The middle layer would join the water in the basin in the manner of a deflected jet with an angle of entry of less than 10 degrees, and the upper layer would join also in the manner of a deflected jet, but with its angle of entry more than 60 degrees--the size of the stilling basin allows this. The low-velocity flow of the lower layer would shield the bottom of the basin from the force of the middle and upper layers, deflecting them away from the revetment. Using this design, the proposed reconstruction of the spillways of the hydrostation could be accomplished in the period between floods and with insignificant expenditures. (Shidler-PTT)
W89-04229

METHOD OF PREDICTING THE CHARACTERISTICS OF A ROCK MASS IN HYDROTECHNICAL CONSTRUCTION,
For primary bibliographic entry see Field 8E.
W89-04230

ENLARGEMENT OF CONCRETE BLOCKS OF ARCH DAMS WITH ALLOWANCE OF THE FORMATION OF RADIAL THERMAL CRACKS,
For primary bibliographic entry see Field 8F.
W89-04231

IMPROVEMENT OF THE METHOD OF CALCULATING SAFE DISTANCES IN UNDERWATER EXPLOSIONS,
For primary bibliographic entry see Field 8G.
W89-04233

GROUT CURTAIN IN THE FOUNDATION OF THE EARTH DAM OF THE MAINA HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8D.
W89-04234

HYDROELECTRIC STATION DAMS AND METHODS OF CONSTRUCTING THEM (REVIEW OF 1980-1986 PATENTS),
V. N. Kazakov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 665-669, May 1988. 7 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 49-51, November 1987.

Descriptors: *Dam construction, *Construction methods, *Hydraulic engineering, *Hydroelectric plants, *Patents, Construction materials, Hydraulic fill dams, Frost prevention, Energy dissipation, Aeration, Mudflows.

An analysis of patents worldwide was made to determine the most promising directions in hydraulic engineering and construction methods for hydroelectric-station dams, particularly dams with energy dissipators in the lower pool. The goal was to find methods of providing maximum operating efficiency without having an adverse effect on ecology. Examples described include: (1) a method for transporting construction materials up a concrete structure having an inclined surface (Japan); (2) a method and device for the layered placement of the material of the core and transition layer of a hydraulic-fill dam (USA); (3) a portable device for use under conditions of frost or falling snow which blows a stream of hot air on the surface of a dam core before placement of additional fill material (Japan); (4) a multi-step diversion dam providing stepwise dissipation of energy (Japan); (5) an overflow dam which has a mixing chamber connected to a diffuser, providing water purification (France); (6) a method of ensuring the noiseless fall of water spilling over the dam crest (Japan); and (7) a dam of spaced frames made of vertical and horizontal bars forming a lattice structure to be constructed in a river channel for protection against mudflows (Japan). A thorough analysis of the most promising of such patented devices and methods will greatly assist the solution of complex technical problems. (Shidler-PTT)
W89-04237

ZONE OF HYDRAULIC RESISTANCE OF UNLINED CANALS,
For primary bibliographic entry see Field 8B.
W89-04239

SOLUTION PROCEDURE FOR THE EARTHQUAKE ANALYSIS OF ARCH DAM-RESERVOIR SYSTEMS WITH COMPRESSIBLE WATER,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 8E.
W89-04320

Group 8A—Structures

DETECTION OF SEEPAGE IN CRACKED DAMS,
Soil Conservation Service, Phoenix, AZ.
For primary bibliographic entry see Field 8G.
W89-04376

NATURAL STREAMS AND WATER RESERVOIRS ON THE GOLAN HEIGHTS: CAN THEY CO-EXIST,
K. Tuch.
Israel Land and Nature, ILANE6 Vol. 14, No. 1, 1988, p 214-218.

Descriptors: *Dam effects, *Environmental impact, *Water sampling, *Water quality, *Reservoirs, *Israel, *Ecological effects, Decomposition, Turbidity, Layering, Physicochemical properties, Biological properties, Streams.

A series of studies, beginning in 1985, are described for gleaning data on the possible effect of the Golan Heights (Israel) water reservoir on the character and features of the Golan streams. Five water sampling stations were chosen as sites for measurements, tests and experiments. A comparison between two pairs (1/2 and 3/4) of stations illuminates the reservoirs influence on the stream. Station 5 was located lower, about 500 m from station 2 and provided data on the range of the reservoir's effect on the streambed. During 1985-1987, monthly measurements were carried out at each of the five stations. The data collected from these examinations may be divided into three tiers which reflect the ecological situation in Nahal Daliyyot and Nahal Gamla: (1) chemical-physical, including temperature, electrical conductivity, turbidity and suspended matter; (2) biological, including effects on stream biota; and (3) ecological, including primary production and decomposition rate of organic matter. During summer, a layering phenomenon takes place causing the formation of two subreservoirs. The stream is fed in summer by water of poor quality, with toxic materials and a low oxygen content. Due to the layering effect in the reservoir's water, the water supplied to the stream has a temperature range of only 2 C. Changes in water temperature may have a direct effect on the invertebrates in the stream. Significant difference were found in turbidity and suspended material amount between Stations 1,2 and 5. It was shown that changes occur downstream in Nahal Daliyyot due to the presence of the reservoir in the middle of the drainage basin. Changes occurred in three of the stream;s characteristics: (1) water quality, (2) composition and abundance of invertebrates which live on pebble bed, and (3) ecological functioning. (Miller-PTT)
W89-04436

8B. Hydraulics

REPAIR WORKS FOR UPLIFT AND SEEPAGE CONTROL IN EXISTING CONCRETE DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 8G.
W89-03339

ANALYSIS OF BANK STABILITY IN THE DEC WATERSHEDS, MISSISSIPPI,
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 8D.
W89-03344

WAX LAKE OUTLET CONTROL STRUCTURE, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W89-03364

SEDIMENT DEPOSITION BEHIND SHEEP CREEK BARRIER DAM, SOUTHERN UTAH,
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 2J.
W89-03968

DESIGN METHOD FOR LOCAL SCOUR AT BRIDGE PIERS,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
B. W. Melville, and A. J. Sutherland.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1210- 1226, October 1988. 10 fig, 2 tab, 28 ref, 2 append.

Descriptors: *Estimating equations, *Scour, *Piers, *Bridges, *Equilibrium, *Hydraulic engineering, Estimating, Flow, Water depth, Sediments, Engineering, Flow characteristics, Hydraulics, Particle size, Mathematical studies.

A design method for the estimation of equilibrium depths of local scour at bridge piers is based upon envelope curves drawn to experimental data derived mostly from laboratory experiments. The laboratory data include wide variations in flow velocity and depth, sediment size and gradation, and pier size, shape, and alignment. Local scour depth estimation is based upon the largest possible scour depth that can occur at a cylindrical pier, which is 2.4D, where D = the pier diameter. This depth is reduced using multiplying factors where clear-water scour conditions exist, the flow depth is relatively shallow, and the sediment size is relatively coarse. In the case of nonrectangular piers, additional multiplying factors to account for pier shape and alignment are applied. The method of estimation of local scour depth is summarized in a flow chart. (Author's abstract)
W89-03978

CRITICAL SCOUR: NEW BED PROTECTION DESIGN METHOD,
Delft Geotechnics (Netherlands).
M. B. de Groot, A. J. Bliek, and H. van Rossum.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1227- 1240, October 1988. 10 fig, 2 tab, 9 ref, 2 append.

Descriptors: *Stream stabilization, *Scour, *Coastal engineering, *River beds, *Protection, Engineering, Hydraulic engineering, Shear, Strength, Coasts, Stress, Shear stress, Bed load, Sediment transport.

A new design philosophy for granular bed protection is given; this is referred to as the 'critical scour' method. Critical scour is defined as the scour that is admissible for protection of a granular bed during its lifetime. First, the traditional 'critical shear' design method is discussed, and some of its shortcomings are described. These shortcomings can be overcome by application of the critical scour method. The basic philosophy of the critical scour method is given, and the two main parameters (load on the cover layer and strength of the cover layer, defined as expected and admissible scour, respectively) are discussed in more detail. The load and strength functions are then combined in a risk analysis. An example from engineering practice demonstrates the advantages of the critical scour method, namely that: (1) it deepens insight into the actual scour and failure processes; (2) it incorporates additional strength parameters, such as layer thickness, which enables the risk of damage to be predicted more accurately. (Author's abstract)
W89-03979

CRITICAL SHEAR STRESS OF COHESIVE BOTTOM SEDIMENTS,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 2J.
W89-03980

CONFINEMENT AND BED-FRICTION EFFECTS IN SHALLOW TURBULENT MIXING LAYERS,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
V. H. Chu, and S. Babarutsi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1257-1274, October 1988. 9 fig, 1 tab, 16 ref, 3 append.

Descriptors: *Friction, *River beds, *Turbulent flow, *Open channel flow, *Shallow water, *Mixing, *Hydraulics, Flow, Anemometers, Streams, Entrainment, Mathematical studies, Mathematical analysis, Engineering, Hydraulic engineering.

The transverse development of the turbulent mixing layers in an open-channel flow of shallow water depth was investigated experimentally to study the confinement and bed-friction effects. Mean and root-mean-square velocity profiles were obtained, using a hot-film anemometer, at a number of cross sections downstream of a splitter plate between two streams of different velocities. In the confinement between the free surface and the channel bed, the transverse spreading rate of the shallow mixing layer was initially twice as large as the nominal rate for the free mixing layer. The spreading rate reduces with distance from the splitter plate under the stabilizing influence of bed-friction, and diminishes to zero in the far field region when the bed-friction number exceeds a critical value of about 0.09. (Author's abstract)
W89-03981

HYDRAULIC RESISTANCE OF RIPPLES,
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
Y. L. Lau.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 10, p 1275-1282, October 1988. 2 fig, 1 tab, 9 ref, 2 append.

Descriptors: *Channel morphology, *Hydraulics, *Resistance, *Ripple marks, *Shear stress, *River beds, Stress, Friction, Flow, Open-channel flow, Sediment transport, Engineering, Hydraulic engineering.

Experiments were conducted to investigate the division of the total shear stress into a friction loss and a form loss component for flows with ripples on the bed. Four different sizes of glass beads were used as bed material, each representing a different value of the dimensionless variable Xi. The experimental evidence indicates that Y', the mobility number related to the frictional shear stress, is dependent only upon Y, the mobility number related to the total shear stress. The variable Xi appears to have an effect only insofar as it determines the value of Y sub cr, the critical mobility number for the initiation of sediment motion. Inspection of other published data revealed much the same dependence. (Author's abstract)
W89-03982

INTRODUCTION TO RAPIDLY-VARIED UNSTEADY, FREE-SURFACE FLOW COMPUTATION,
Geological Survey, Reston, VA. Water Resources Div.
D. R. Basco.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 83-4284, 1987. 101p, 8 fig, 4 tab, 77 ref.

Descriptors: *Open-channel flow, *Rapidly-varied flow, *Free-surface flow, *Unsteady flow, *Finite-difference methods, Hydraulic engineering, Hydraulics, Hydrodynamics, Fluid mechanics.

Many unsteady flows in hydraulics occur with relatively large gradients in free surface profiles. The assumption of hydrostatic pressure distribution with depth is no longer valid. These are rapidly-varied unsteady flows (RVF) of classical hydraulics and also encompass short wave propagation of coastal hydraulics. The purpose of this report is to present an introductory review of the Boussinnesq-type differential equations that describe these flows and to discuss methods for their numerical integration. On variable slopes and for large scale (finite-amplitude) disturbances, three independent derivational methods all gave differences in the motion equation for higher order terms. The importance of these higher-order terms for riverine applications must be determined by numerical experiments. Care must be taken in se-

lection of the appropriate finite-difference scheme to minimize truncation error effects and the possibility of diverging (double mode) numerical solutions. It is recommended that practical hydraulics cases be established and tested numerically to demonstrate the order of differences in solution with those obtained from the long wave equations of St. Venant. (USGS)
W89-04073

CALCULATION OF THE CURVE OF THE FREE SURFACE OF A FLOW IN A CIRCULAR CONDUIT,
L. G. Rabukhin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 697-700, June 1988. 2 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 23-24, December 1987.

Descriptors: *Hydraulics, Conduits, *Fluid flow, *Hydraulic models, *Hydraulic design, *Free surfaces, Model studies, Hydraulic engineering, Calculations, Flow discharge.

Accurate and convenient methods of hydraulic calculation for circular conduits are necessary, including determination of the curves of the free surface of the flow, from which the depth of filling of the conduit and, consequently, the flow regime can be calculated. Several points relevant to calculation of the free surface of the flow in circular and ovoidal conduits are discussed and comparison are made with previously published methods. In the calculation method developed here, the value of the normal depth (h sub 0) is not used at all, thus making the method applicable for any combination of initial data. Previously published figures determined by other methods are shown to contain errors. (Rochester-PTT)
W89-04185

HYDRAULIC TESTS OF THE SPILLWAY OF THE ZEYA HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04187

CALCULATION OF THE NEAR FIELD OF VELOCITIES AND TEMPERATURES BEYOND A SURFACE DISCHARGE OF HEATED WATER,
I. A. Sherenkov, and A. P. Netyukhailo.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 33-39, July 1988. 6 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 29-33, January 1988.

Descriptors: *Waste heat, *Temperature gradient, *Path of pollutants, *Heated water, *Mathematical studies, Plumes, Jets, Fluid mechanics, Cooling water, Thermal powerplants, Nuclear powerplants, Water temperature, Mixing, Thermal stratification, Stratified flow, Mathematical equations.

Mathematical methods are described for analyzing the problem of buoyant jets of water entering a receiving water body of a different temperature. These equations address two problems of importance in typical water discharge structures for the circulating cooling systems of thermal or nuclear power plants: (1) determining the type of contact between the heated jets being discharged and the receiving water body as well as the characteristics of the buoyant jet at the end of the initial stretch and (2) determination of the near field velocities and temperatures for the buoyant jet itself. The theoretical results were confirmed by data from experimental investigations of stratified mixing layers. (Rochester-PTT)
W89-04197

CONSIDERATION OF METEOROLOGICAL FACTORS WHEN CALCULATING LARGE CANALS,
A. D. Girgidov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 39-44, July 1988. 1 fig, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 33-36, January 1988.

Descriptors: *Hydraulic design, *Fluid dynamics, *Wind-driven currents, *Canal design, *Channel flow, *Shear stress, Flow discharge, Mathematical equations, Bernoulli equations, Energy, Free surfaces, Canals, Atmospheric pressure, Shallow water, Slopes.

It has been customary to assume that atmospheric factors are of negligible importance in determining the characteristics of flow in design of canals. The present article demonstrates that this is not always true, and that depending on canal size and slope meteorological conditions may need to be considered. In shallow-water equations (particularly the St. Venant equations), meteorological conditions on the free surface (normal and shear stresses) are taken into account. The approach presented here based on the equation of balance of mechanical energy and ultimately on the Bernoulli equation, does not permit obtaining such detailed information about the interaction of the meteorological and hydraulic factors. It does, however, provide simple estimates that allow one to establish when the effect of meteorological factors on the hydraulic characteristics of flows in canals should be considered. (Rochester-PTT)
W89-04198

HYDRAULIC RESISTANCES AND SEDIMENT DISCHARGE IN THE CASE OF BED RIPPLES,
E. V. Pletneva, and A. Z. Bodanov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 44-49, July 1988. 7 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 36-39, January 1988.

Descriptors: *Ripple marks, *Sediment discharge, *Hydraulic friction, *Channel morphology, *Hydraulics, Dunes, Bed-load discharge, Flow velocity, Flushing, Froude number, Reynolds number, Hydraulic roughness, Flumes, Turbidity, Mathematical equations, Resistance.

The key issues of the problem of hydraulic resistances are: the relationship of roughness and the resistance coefficient (lambda) and the relation between hydraulic resistance and sediment discharge. Experiments were conducted in a flume (length 20 m, breadth 1 m, height 0.6 m), with sand of 0.23 mm average diameter. Changes in the Froude number (Fr) and the Reynolds number (Re) in relation to hydraulic resistance were determined. The use of the complex parameter Fr.Re made it possible to obtain a single graphic relation for hydraulic resistances for all the experiments. The resistance laws are shown to be completely different for a ripple bed from those of a dune bed. Transition to the larger forms begins at around Fr = 0.3, and the difference in height of the channel forms is maximum at Fr = 0.4; at greater values the dunes wash away. When Fr > 0.4, the amount of the bed load increases markedly, the turbidity changes substantially, the upper layers of the flow become clearer, and a part of them cease to participate in sediment transport. Therefore an increase in water discharge does not lead to an increase in sediment discharge as much as a decrease in depth, which is the equivalent to an increase in the Froude number. Knowledge of this fact can be used for composing more rational schemes for flushing the lower pools of structures that will make possible saving water. (Rochester-PTT)
W89-04199

INVESTIGATION OF THE ICE REGIME OF A STRETCH OF THE DAUGAVA RIVER UNDER REGULATED CONDITIONS,
V. N. Karnovich, G. A. Tregub, B. F. Balagurov, V. P. Tveritnev, and A. A. Pastors.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 598-604, April 1988. 3 fig, 3 tab, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 26-29, October 1987.

Descriptors: *Ice jams, *Rivers, *Regulated flow, *Flooding, *Dam effects, *Soviet Union, Slush, Hydroelectric plants, Flow discharge, Flood plains, Bypass channels, Flood control.

The ice-dam-and-jam-caused water levels on the Daugava River at Ekabpils are determined mainly by the volumes of shuga (slush) and ice accumulating on the jam-prone stretch of river and depend on river discharge. Under current conditions, there is a 1% probability of a 10.4 m ice-jam/dam-caused water-level rise above the gage datum at Ekabpils. With the construction of a hydrostation at Daugavpils the maximum volume of shuga and ice in the jam-prone stretch at Ekabpils will decrease by 50%, and by 80% with a hydrostation at Ekabpils, compared with existing conditions. Even under the most unfavorable conditions--11 million cubic m of ice and shuga below the dams and discharge through the hydrostation structures of 2500 cubic m/sec--the height of the maximum rises of the dam/jam-caused water levels at Ekabpils will not exceed 6.8 m with normal operation of the Daugavpils hydrostation and 6.2 m with the Ekabpils hydrostation. To control ice dams and jams in the zone of narrowing of the backwater of the Daugavpils hydrostation reservoir, a bypass channel can be constructed in the Daugava river flood plain for bypassing water around the ice jam and for lowering ice-dam/jam-caused water levels. The dimensions of such a channel can be assigned on the basis of technical and economic parameters, optimal discharge, and most-probable ice dam and jam location. (Shidler-PTT)
W89-04225

REDUCTION OF LOCAL SCOUR AT WING DAMS OF BRIDGE CROSSINGS,
For primary bibliographic entry see Field 8A.
W89-04226

ZONE OF HYDRAULIC RESISTANCE OF UNLINED CANALS,
O. M. Aivazyan.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 672-680, May 1988. 3 fig, 4 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 54-58, November 1987.

Descriptors: *Hydraulics, *Canals, *Resistance, *Hydraulic roughness, Roughness coefficient, Chezy equation, Darcys law, Hydrologic data collections, Cohesive soils, Cohesionless soils, Irrigation canals, Mathematical equations.

The problem of the zone of hydraulic resistance of unlined canals is solved on the basis of a new analysis of extensive data on the Darcy (Chezy) coefficient of canals in cohesive and noncohesive soils. Extensive material on the Chezy coefficient of canals in cohesive soils is contained in the consolidated data from on-site investigations of irrigation canals in Central Asia during the period 1914-1956. For actual data on canals in noncohesive soils, i.e., in a dynamically-stable sand bed, the data of the central irrigation bureau of India for 1939-1944 were the main source. A mixed zone of hydraulic resistance distinguished by ascending curves of resistance was found to be characteristic of unlined canals in cohesive soils and in a sand bed. The formulas presently used for calculating the Chezy coefficient do not correspond to the real nature of hydraulic resistance of unlined canals. Their use for hydraulic calculations of unlined canals is not guaranteed against gross errors. The relation of the parameters constant over the entire range of actual data covered is presented, corresponding to the real characteristics of the zone of resistance of unlined canals, and leading to a marked decrease of deviations between calculated and actual values when it is used. The results of the present work are a further confirmation of the desirability of replacing the generally-accepted relation. (Shidler-PTT)
W89-04239

SURFACE-DRIVEN FLOWS IN LONG RECTANGULAR ENCLOSURES,
Centre National de la Recherche Scientifique, Marseille (France). Inst. de Mecanique des Fluides de Marseille.
B. Roux, H. Ben Hadid, and P. Laure.
Advances in Water Resources AWREDI, Vol. 11, p 15-20, March 1988. 12 fig, 10 ref.

Descriptors: *Hydrodynamics, *Fluid mechanics, *Wind-driven currents, *Hydraulic geometry, *Finite difference methods, *Water circulation,

*Seiches, Shear stress, Water circulation, Viscous flow, Capillarity, Numerical analysis, Theoretical analysis, Reynolds number, Stokes law.

Numerical and theoretical studies of the motions of viscous fluids driven by a constant stress acting in long rectangular enclosures are described. This problem was originally addressed to study the flow behavior of molten metals driven by thermocapillarity in open vessels during directional solidification by the Bridgman technique and the study has now been extended to a closely-related problem,--the flows occurring in a water basin under a stress generated by an external wind. The problem was handled by solving the 2-D Navier/Stokes equations by an efficient finite-difference technique. Computations were done for rectangular basins with large (12.5 and 25) aspect ratios (length/height), and for a wide range (35 to 35,000) of the surface Reynolds number (Re). A notable feature of the solutions is the totally-different end circulations. For small values of Re a fully-developed flow is reached in the central region of the basin; it corresponds to a Couette solution, valid for indefinitely long layers. In addition to this central region, an upwind region in which the flow is accelerated to reach this Couette flow and a downwind region in which the flow is decelerated and deflected by the endwall are exhibited. For higher Re values (>20 times the aspect ratio), the length of the fully-developed Couette flow is reduced and the flow even disappears while, simultaneously, the upwind and downwind regions collapse. (Shidler-PTT)
W89-04241

DISSIPATIVE FINITE ELEMENT MODEL FOR DISCONTINUOUS UNSTEADY FLOW IN OPEN CHANNEL,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
For primary bibliographic entry see Field 2E.
W89-04260

EFFECT OF DIFFERENT PARAMETERS ON ENTRANCE RESISTANCE OF CORRUGATED PLASTIC DRAINS,
Ministry of Public Works, Salonika (Greece).
E. Tiligadas.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 225-233, June 1988. 4 fig, 13 ref.

Descriptors: *Drains, *Flow resistance, *Hydraulics, Corrugated plastic drains, Entrance resistance, Flow velocity, Pressure head, Hydraulic geometry, Flow pattern.

The influence of water level inside the drain on the flow conditions at the immediate vicinity of the drain were analyzed. Laboratory tests were conducted to evaluate the effects of the mode of water supply, the outflow head, and the total head on the entrance resistance of a 50 mm diameter corrugated plastic drain. A non-symmetrical radial flow theory was used to evaluate the entrance resistance of the drain from the experimental data. It was concluded that the apparent entrance resistance diminishes with the augmentation of the water level inside the drain, for a given hydraulic head, and when the hydraulic head increases for a given outflow condition. These results could explain some differences that occur between laboratory and field measurements. It is advisable that the precise description of the flow pattern, and, if necessary, an additional flow resistance should be considered and taken into account. (White-Reimer-PTT)
W89-04265

WATER CONVEYANCE IN CHANNELS WITH SEMICIRCULAR CROSS SECTIONS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
J. D. Demetriou, and A. I. Nanou-Giannarou.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 273-283, June 1988. 15 fig, 14 ref.

Descriptors: *Open-channel flow, *Hydraulics, *Flow characteristics, *Channel morphology, *Water conveyance, Flow resistance, Irrigation canals, Uniform flow, Shear stress, Boundary processes.

One of the most important technical problems in the field of agricultural development is water conveyance by distribution systems consisting of open channels. In this experimental study, measurements concerning uniform flow in open channels, with semicircular cross sections and smooth or rough boundaries, are presented, analyzed, and discussed. Based on local velocity and boundary shear stress measurements, an effort is made to interpret the momentum and energy distribution, the internal boundary shear force and discharge distributions, the maximum boundary shear stress distributions as well as the Manning's n and friction factor's f variation, obtained for various groups of smooth or rough open channels used herein. The results show a significant consistency and an attempt was made to analyze and interpret the flow behavior mechanism. (White-Reimer-PTT)
W89-04269

DETAILS OF THE FLOW AND BOTTOM PRESSURE DOWNSTREAM OF A THIN-PLATE WEIR,
Cambridge Univ. (England). Dept. of Engineering.
S. Papoutsi-Psychoudaki, and P. Sutton.
Agricultural Water Management AWMADF, Vol. 13, No. 2-4, p 369-382, June 1988. 8 fig, 8 ref.

Descriptors: *Gaging, *Scour, *Weirs, *Flow pattern, *Flow regulators, Gaging stations, Channel flow, Pressure distribution.

Laboratory experiments were carried out to investigate the flow downstream of a well-ventilated thin-plate weir with a sharp-edged horizontal crest. The experiments covered a range of upstream total head for a weir height from 1.21 to 1.55 relative to the channel bed on the downstream side of the weir. The pool under the nappe was confined laterally by vertical end walls, and the air space between the pool and the nappe was ventilated to atmospheric pressure. The main dimensions of the pool under the nappe were found to satisfy the simple relation (depth/W) = (H/W) - 0.88. The pressure on the bed under the pool was approximately constant. Downstream of the pool, the pressure on the bed rate steeply to a peak in the region where the flow from the nappe impinges on the bottom. The maximum pressure reached is well below the total pressure of the weir. From the peak, the pressure falls steeply an then levels off under the tailwater at approximately the hydrostatic pressure corresponding to the tailwater depth. The pressure distributions measured on the bed as far as, and including, the impingement region collapse together very well when plotted in terms of a non-dimensional pressure coefficient and the non-dimensional distance downstream of the weir crest. The shape of the pressure peak in the impingement region resembles that under a submerged impinging jet. The shape of the pressure peak in the impingement region resembles that under a submerged impinging jet. The time-mean reattachment position is always very close upstream of the pressure maximum. The pressure fluctuations on the channel bottom are much higher in the impingement region than elsewhere, reaching a maximum very close to the reattachment position. (White-Reimer-PTT)
W89-04276

TIME-MARCHING APPROACH FOR PIPE STEADY FLOWS,
National Research Inst. of Agricultural Engineering, Yatabe (Japan). Dept. of Hydrological Engineering.
M. Shimada.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1301-1320, November 1988. 6 fig, 5 tab, 14 ref.

Descriptors: *Hydraulics, *Pipe flow, *Steady flow, *Pipelines, Civil engineering, Friction, Mathematical studies, Velocity, Flow characteristics.

The time-marching approach (TMA) for determining steady-state flows as the asymptotic limit of transient flows in pipelines has been improved. It is shown that the rate of convergence to steady state is increased by reducing the spectral radius of a coefficient matrix of a state-vector equation, which is composed of the basic equations and boundary conditions linearized about the steady condition. A generalized TMA theory using the method of characteristics has been formulated and the spectral radius is minimized by changing system parameters to imaginary ones by using the energy and mass conservation equations. In addition, a practical method was designed to efficiently handle TMA in large pipelines without having to calculate eigenvalues. The TMA has been extended to accurately estimate friction factors using an explicit approximation to the Colebrook-White formula. (Author's abstract)
W89-04358

TIDAL INLET HYDRAULICS,
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
For primary bibliographic entry see Field 2L.
W89-04359

SURFACE FILMS AND MIXING IN TWO-LAYER FLUID,
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 2H.
W89-04361

COMPUTER-AIDED DESIGN FOR CHANNELIZATION,
San Diego State Univ., CA. Dept. of Chemistry.
H. H. Chang, and Z. Osmolski.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1377-1389, November 1988. 11 fig, 15 ref.

Descriptors: *Hydraulic design, *Computer-aided design, *Computers, *Channeling, *Channel scour, *Design floods, Hydraulic structures, River beds, Sediments, Sedimentation, Mathematical studies, Sediment load, Topography, Fluvial sediments.

The bank protection and grade controls of a river channel must be designed to contain the design flood and extend below the potential riverbed scour. Because of the convoluted relationships governing the flow and sediment processes, mathematical simulation becomes an effective means of evaluating channelbed scour under any flow pattern and design configuration. Channelization of the Santa Cruz River has been designed based upon the pattern of river channel responses simulated using a calibrated mathematical model. Scour and fill of the channel bed invoked by the longitudinal imbalance in sediment load are simulated; they are also tied in with the effects of the streamwise variation in spiral motion that induces an uneven bed topography, characterized by greater scour near the concave bank. Variable top and toe elevations for hydraulic structures have been determined and employed to make more efficient use of construction materials while providing effective protection against erosion. The study demonstrates the procedure with which the design configuration of a flood control channel may be determined. (Author's abstract)
W89-04362

PLANE GATE ON STANDARD SPILLWAY,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8C.
W89-04363

SHAPE EFFECTS ON FLOW RESISTANCE IN HORSESHOE CONDUITS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
T. W. Sturm, and D. A. King.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1416-1429, November 1988. 6 fig, 1 tab, 22 ref.

Descriptors: *Hydraulic geometry, *Flow resistance, *Conduits, *Open channel flow, *Channel flow, *Hydraulics, Friction, Velocity, Dimensional analysis, Model studies, Pipes.

An experimental study of open channel flow resistance in horseshoe-shaped conduits is reported. The friction factor is shown to increase approximately 20 percent in comparison to values taken from the Moody diagram for depths larger than half-full. For depths less than half-full, the friction factor agrees with that determined directly from the Moody diagram with four times the hydraulic radius taken as the length scale. The resultant changes in the ratio of part-full velocity to full-flow velocity are investigated and compared with field results for circular pipes. For small relative depths of flow, the experimental results for relative velocity agree with those obtained using the Moody-diagram friction factor for a horseshoe conduit with no shape correction, but they approach field results for circular conduits at higher relative depths of flow for which a shape correction is needed. (Author's abstract)
W89-04364

8C. Hydraulic Machinery

WAYS TO CREATE AND IMPROVE HIGH-PARAMETER HYDRAULIC DRIVES FOR HYDRAULIC STRUCTURES,
V. Y. Martenson, I. K. Kaplan, V. D. Ser'ga, and A. A. Kholodov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 681-685, June 1988. 2 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 12-15, December 1987.

Descriptors: *Hydraulic drives, *Construction methods, *Hydraulic design, *Hydraulic engineering, *Hydraulic structures, *Soviet Union, Design criteria, Hydraulic gates, Testing procedures, Hydraulic equipment.

The results are reported of decisions made by Soviet engineering groups seeking ways to improve hydraulic drives and make their assembly and testing more compatible with modern high-speed construction procedures. It is suggested that a specialized group be formed and a mock-up device be constructed for training workers responsible for installation, testing, adjustment, and start-up of hydraulic cylinders at hydraulic structures under construction. The development of a set of devices for operating the hydraulic drives will make it possible to increase their operating reliability and to improve the working conditions of the personnel. Development of new types of short-stroke devices should make it possible to solve the problem of creating economical layouts of modern hydraulic structures. The manufacture of the stepping hydraulic drive with a short-stroke cylinder as a single 'whole' mechanism provides a universal mechanism both for operating the gates and for various installation purposes. (Rochester-PTT)
W89-04181

DAMMING OF THE VILYUI RIVER CHANNEL AT THE CONSTRUCTION SITE OF THE VILYUI III HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04184

INCREASE OF THE RELIABILITY AND COST EFFECTIVENESS OF THE LENINGRAD RIVER FLOOD CONTROL GATES,
P. R. Khlopenkov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 700-705, June 1988. 2 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 30-33, December 1987.

Descriptors: *Floodgates, *Reliability, *Cost analysis, *Soviet Union, *Hydraulic Machinery, *Hydraulic structures, Leningrad, Design criteria, Roller gates, Radial gates, Seasonal variation, Ice.

A design for gates for flood control in Leningrad (Soviet Union) is proposed as an alternative to the one developed by the Leningrad Special Design Department of Steel Hydraulic Structures. Both rolling gates and radial gates are discussed. The rolling gates, which have an operating area of 200 x 25 m, have no analogues in either Soviet or foreign hydrotechnical practice. The design challenge is increased because most of the floods occur in winter and the water is saturated with shuga and large masses of ice up to 0.6 m in thickness. The alternative designs presented lead to substantial reduction in materials use, better performance with less risk, and cost reductions in the millions of rubles. (Rochester-PTT)
W89-04186

CURRENT TRENDS IN THE DEVELOPMENT OF PUMPED-STORAGE STATIONS IN THE WORLD,
M. I. Klasson.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 719-727, June 1988. 6 fig, 31 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 42-47, December 1987.

Descriptors: *Pumped storage, *Hydroelectric plants, *Electric power production, *Hydraulic structures, *Water resources development, *Soviet Union, Electric power demand, Design criteria.

Characteristics of several pumped storage stations (PSSs) from the Soviet Union and other countries are described to exemplify the recent trends in PSS development. The main progressive trends recognized are: a decrease in unit expenditures, an increase in the efficiency of power systems, a reduction in adverse environmental effects, development at higher heads and higher capacity, underground or semi-underground arrangement of powerhouses and reservoirs, incorporation of PSSs into power complexes, including hydroelectric station (HES) complexes, flexible adaptation to local conditions, and provision for greater flexibility in operating regimes to accommodate system demand. Changes in regime functions of PSSs are necessitated by the development of modern technologies requiring a high degree of reliability in electrical supply and a high quality of electrical energy and by the use of large power units at thermal power stations, which substantially increases the significance of the rapid startup reserve and rotating reserve. Estimates by specialists place the proportion of the system functions that should be performed by the PSS in a power system at between 10 and 25% of the total capacity. (Rochester-PTT)
W89-04190

EXPERIENCE IN CONSTRUCTING THE GRAVITY ARCH DAM OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04191

SELECTION AND INVESTIGATION OF SUPPORTS OF THE UNDERGROUND GENERATOR HALL OF THE ROGUN HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8G.
W89-04192

SEISMIC LOADS ON THE FOUNDATIONS OF HYDRAULIC STRUCTURES DURING STRONG EARTHQUAKES,
For primary bibliographic entry see Field 8E.
W89-04195

FORTY YEARS OF OPERATION OF THE HYDRAULIC STRUCTURES OF THE SHIROKOVO HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04201

CONCERNING THE TECHNOLOGY OF CONSTRUCTING PUMPED-STORAGE STATIONS OF A NEW DESIGN,
For primary bibliographic entry see Field 8A.
W89-04202

RECREATIONAL USE OF THE RESERVOIRS OF HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 2H.
W89-04224

EXPERIENCE AND PROSPECTS OF USING VIBRATING ROLLERS IN HYDROTECHNICAL CONSTRUCTION,
T. I. Adamyants.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 639-645, May 1988. 3 fig, 1 tab, 6 refs. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 33-37, November 1987.

Descriptors: *Rolled-earth dams, *Dam construction, *Construction equipment, *Vibrations, *Soil compaction, Research facilities, Industrial plants, Industrial production, Future planning, Foreign design practices, Soviet Union.

Heavy vibrating rollers are the most effective compacting machines for layer-by-layer mass placement of earth materials. However, the Soviet Union has not implemented industrial production for hydrotechnical construction. The only Soviet heavy vibrating roller, the PVK-70EA, had only limited production, insufficient to meet the need. Vibrating-equipment production (including its manufacture in cooperation with foreign firms) requires immediate creation of experimental facilities and enlargement of production facilities appropriately outfitted with equipment. Only then will it be possible to provide builders with highly productive compacting equipment and eliminate an important bottleneck in the construction of large hydraulic structures. Even with a more conservative estimate of the requirement for vibrating rollers in the near future, however, it will not be possible to manage without minimum purchases of equipment from abroad. An analysis of technical data on vibrating rollers offered for sale in the USSR by Eastern-Bloc countries and firms of capitalistic countries, as well as the known experience of operating some of them, showed that vibrating rollers of the type CA 51S of the Dynepac firm (Sweden), towed vibrating rollers of type A-12 (German Democratic Republic), and the Bomag BW-215D heavy roller (Federal Republic of Germany) have acceptable vibration parameters. (Shidler-PTT)
W89-04232

CREATION OF HIGH-HEAD MECHANICAL EQUIPMENT OF LARGE-CAPACITY OUTLETS,
V. Y. Martenson.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 656-662, May 1988. 1 tab, 13 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 43-47, November 1987.

Descriptors: *Hydraulic machinery, *Mechanical equipment, *Hydraulic engineering, *Pressure head, *Outlets, *Soviet Union, High pressure gates, Hydraulic structures, Pressure conduits, Hydraulic design, Soviet Union.

The construction of large modern hydraulic and hydropower structures, especially high-head ones and those in northern regions of the Soviet Union, required the creation of new types of hydromechanical equipment (HME) designed for passing large discharges, withstanding considerable hydrodynamic loads, and operating reliably under the harshest climatic conditions. Results of theoretical studies, research and development, full-scale tests, and available operating experience include the following: (1) The combination of a high-head outlet with a universal gate chamber, including vertical slide gates with a curved downstream edge and providing stable separation of the flow from the elements of the chamber, and reliable operation during passage of discharge up to 2000 cubic m/sec with a head up to 200 m; (2) a new type of stepping hydraulic drive with a lifting capacity and working stroke considerably exceeding the performance of earlier designs has been created; and (3) an outlet whose stable operation is provided by a positive pressure over the radius of the conduit

lining (due to the centrifugal force of the flow) and which uses the effect of the air cushion under the flow. With respect to design load, reliability, and operating life, the newly-created HME technology considerably broadens the technical possibilities in constructing high-head hydro developments. (Shidler-PTT)
W89-04235

PREVENTION OF REVERSE ROTATION OF A PUMPING UNIT,
A. Dadazhanov, A. S. Aliev, and A. V. Saidakhmedov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 662-664, May 1988. 2 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 47-48, November 1987.

Descriptors: *Hydraulic machinery, *Hydraulic design, *Pumps, *Electrical equipment, *Mechanical failure, Pumping plants, Pressure conduits, Pressure head, Rotors, Maintenance costs, Shock loads.

At modern large pumping stations vertical salient-pole synchronous electric motors (SM) serve as the electrical drives for the pumps. During routine and emergency disconnection of the pumping unit from the power supply, the water in the pipelines reverses its movement, which leads to reverse rotation of the rotor of the SM. After emptying the pressure pipeline, the rotation of the pump creates a negative head which is deleterious to thrust bearings and guide bearings, since unfavorable conditions for formation of the oil film between the friction planes are created. An electrical braking method is described which prevents motor reversal by delivering to the stator and rotor windings a direct current at the time of the change in the direction of rotation of the rotor, preventing reverse rotation. A braking device proposed for automatic maintenance of the shaft of the pumping unit at a zero rotational velocity has a simple electrical circuit and uses standard rectifiers. The use of the device will make it possible to considerably reduce the tangential forces and radial stresses of the rotor, which will have a favorable effect on the operation of thrust and guide bearings, and, consequently, expenditures on overhauling the pumping unit will decrease, and will also make it possible to reduce the dynamic loads on elements of the pipeline and structural elements of the pumping-station building. (Shidler-PTT)
W89-04236

HYDROELECTRIC STATION DAMS AND METHODS OF CONSTRUCTING THEM (REVIEW OF 1980-1986 PATENTS),
For primary bibliographic entry see Field 8A.
W89-04237

PLANE GATE ON STANDARD SPILLWAY,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, and R. Bremen.
Journal of Hydraulic Engineering JHENDB, Vol. 114, No. 11, p 1390-1397, November 1988. 5 fig, 2 tab, 7 ref.

Descriptors: *Hydraulic engineering, *Flow characteristics, *Flow discharge, *Spillway gates, *Spillways, Plane flow, Spillway crests, Discharge coefficient, Hydraulics.

Using a semiempirical approach, the discharge characteristics of standard spillways controlled by a plane vertical gate, mounted on the spillway crest, were investigated for free flow. It was shown that the proposed equation for discharge depends on the spillway geometry, the gate opening, and the actual head on the spillway. The equation was established for a wide range of the relative head. A diagram is presented for both gated and ungated standard spillway flow. All quantities are normalized by the design parameters. Therefore, this plot can be applied simply. It should be noted, however, that the transition from gated to ungated flow condition is accompanied by a sudden decrease of head, and that from ungated to gated flow by an increase of head. (Stoehr-PTT)
W89-04363

SOME RECENT DEVELOPMENTS IN SEWAGE SLUDGE PUMPING,
Niersverband, Viersen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W89-04467

8D. Soil Mechanics

ANALYSIS OF BANK STABILITY IN THE DEC WATERSHEDS, MISSISSIPPI,
Queen Mary Coll., London (England).
C. R. Thorne.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A192 249. Price codes: A03 in paper copy, A01 in microfiche. Third Periodic Report, November 1987 - January 1988. 11p, 5 fig, 1 ref. U.S. Army Contract DAJA45-87-C-0021.

Descriptors: *Bank erosion, *Mississippi, *Slope stability, *Mathematical analysis, Long Creek, Johnson Creek, Goodwin Creek, Computer programs.

A computer program for assessment of bank stability with respect to initial and subsequent failures is being used at the Army Engineers Waterways Experiment Station (WES) and at Water Engineering Technology (WET) Testing of the stability analysis against existing and new data for Long Creek has produced encouraging results. The simplest procedure is to plot the bank heights and angles extracted from the Corps' surveys on a graph together with the line of limiting stability derived from the analysis of initial failures. To complete testing of the stability analysis, repeat surveys will be carried out at the field sites on Long, Goodwin and Johnson Creeks in further field trips to North Mississippi. This work will supply the detailed data on the geometry at failure needed to test the full analysis, rather than just the derived curves shown here. The analysis for banks with gentle slopes will be developed and applied to Long Creek and a user's manual similar to that for the steep banks will be written. (Lantz-PTT)
W89-03344

KONTAGORA DAM: ASPECTS OF DESIGN AND CONSTRUCTION OF AN EMBANKMENT DAM RELEVANT TO A REMOTE RURAL AREA OF WEST AFRICA,
For primary bibliographic entry see Field 8A.
W89-03932

ISANLU DAM, NIGERIA,
N. S. M. Berry, H. S. Eadie, and I. R. MacGregor.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, p 875-894, October 1988. 10 fig, 24 ref, 3 append.

Descriptors: *Dam design, *Dam construction, *Nigeria, *Rockfill dams, Rural areas, Rock excavation, Membranes, Design criteria, Embankments, Site selection, Rockfill, Grouting, Leakage.

Isanlu Dam has a height of 18.6 m and a crest length of 120 m and forms part of a rural water scheme in Nigeria. Because of a shortage of natural materials and the foundation conditions it was determined this would be a rockfill dam. As there were no suitable natural materials for a core, and construction had to be completed in one dry season, a high-density polyethylene geomembrane seal was adopted. Aspects of design that were considered in detail included material behavior, security in case of leakage and the design of the covering layer. The membrane is secured to the grout cut-off with a water bar type detail aided by an apron buried in an upstream blanket. The final thickness of sheet adopted was 3.5 mm. During construction, cut-off details had to be revised because of the difficulties in excavating the exposed bedrock. Laying and welding of the membrane took 12 days within the construction period of 12 months. (Author's abstract)
W89-03933

CONSOLIDATION OF AN UNSATURATED ILLITIC CLAY SOIL,
National Soil Erosion Lab., West Lafayette, IN.
M. A. Nearing, L. T. West, and J. M. Bradford.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 4, p 929-934, July/August 1988. 3 fig, 4 tab, 29 ref.

Descriptors: *Soil mechanics, *Soil water, *Soil stabilization, Water stress, Soil water suction, *Clays, *Illite, *Soil compaction, Stress, Soil science, Soil water, Soil strength, Strength, Density, Soil density, Soil types, Viscous flow, Elastic properties, Compressive strength.

Soil stabilizes with time after disturbance as a function of thixotropy and soil water stress. A study was undertaken to delineate the effects of soil water suction history and thixotropy on soil stabilization and effective stress. Unconfined compressive strength, tensile strength, density, and effective stress as a function of water stress history and time were obtained for a Paulding clay soil. Compressive strength was five times greater at 64 kPa suction than at 4 kPa suction, and twice as great at 32 d than at 4 d. Density also increased with suction and time. Compressive strength at 2 kPa suction was 1.8 and 3.2 kPa for prestress suctions of 4 and 32 kPa, respectively; and was 4.4 and 8.9 kPa for prestress suction of 64 kPa after 4 and 32 d, respectively. Prestress and time had no effect on tensile strength apparently because no volume change was allowed. The data supported the hypothesis that strength in unsaturated soil was controlled by soil water stress history. Prestress due to drying induced bonding, which persisted after suction was released if volume change was not restricted. Effective stresses due to soil water suction were greater for strength than for volume change and were influenced by soil structure for the case of strength, but not for the case of volume change. (Author's abstract)
W89-04013

INDUSTRIAL DESIGN OF AN EARTH OVERFLOW DAM,
For primary bibliographic entry see Field 8A.
W89-04182

SEEPAGE STRENGTH OF GYPSINATE FOUNDATIONS OF HYDRAULIC STRUCTURES,
M. N. Terletskaya, and N. V. Metonidze.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 690-691, June 1988. 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 18-19, December 1987.

Descriptors: *Soil mechanics, *Hydraulic structures, *Dam foundations, *Seepage control, Hydraulic design, Leaching, Gypsum, Foundation failure, Dams, Deterioration, Grouting, Construction methods, Dam construction, Tbilisi Reservoir, Soviet Union.

When designing hydraulic structures in gypsinate soils it is necessary to calculate also the casual piping strength of soils. In the Tbilisi Reservoir (Soviet Union), it was observed that the initial stage of piping deformations took 30 yr to develop. A calculation determined the duration of leaching of gypsum in the observed stretch to be about 100 yr. Observations showed that disturbance of the casual strength occurred after 30 yr. Consequently, a correction factor, K sub c, of 0.3 is assumed. If this factor had been known when designing the cutoff measures in the foundation of the dam of the Tbilisi Reservoir, it would have been necessary to construct the grout curtains simultaneously with the foundation, which would have eliminated occurrence of piping deformations. (Rochester-PTT)
W89-04183

INTERPRETATION OF THE RESULTS OF SHEAR TESTS OF SANDS,
I. P. Ivanov, N. P. Ivanikova, and M. B. Zavodchikova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 711-714, June 1988. 3 fig, 2 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo,

No. 12, p 37-39, December 1987.

Descriptors: *Sands, *Soil mechanics, *Shear tests, *Data interpretation, *Soil tests, Porosity, Strength, Dilatancy, Density, Clays, Slopes, Mathematical studies, Cohesion.

A major conclusion from the work of A. L. Kryzhanovskii, R. S. Shelyapin, and V. A. Khomyakov on determining the strength characteristics of sands and clays was that 'the value of the angle of internal friction is determined by the composition of the soil and does not depend on its density.' Experimental studies aimed at testing this conclusion are described. The effect of peak and residual strength was characteristic for the investigated sands only in specimens with a density of more than 1.54-1.55 g/cu cm, which corresponds to a porosity (n) of less than 42%. The ratio of the peak strength to the residual in the present experiments was close to unity. A general tendency toward increase in this ratio was noted with an increase in density: (1) during shear positive ($n > 42\%$) or negative ($n < 42\%$) dilatancy occurs; (2) the dilatancy ends when the maximum value of the shearing force is reached; (3) the angle of the slope of the relation shear strength/porosity plotted for the maximum value of shear stresses varied from 11 degrees for the loosest possible state to 35 degrees for the densest possible state in the experiments; (4) strength diagrams show that, for sands of different density, the angle of friction varies from 11 to 30 degrees. In this case, the strength due to cohesion varies from 0.002 MPa for the loosest possible to 0.02 MPa for the densest specimens. It is concluded that the bearing capacity of sands should be calculated with consideration of the effect of their density. (Rochester-PTT)
W89-04188

STRENGTH OF THAWED AND FROZEN SOILS OF DAM CORES UNDER CONDITIONS OF TRIAXIAL INDEPENDENT LOADING BY TENSION AND COMPRESSION,
I. M. Vasil'ev, L. N. Sinyakov, and V. A. Mel'nikov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 27-32, July 1988. 6 fig, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 25-29, January 1988.

Descriptors: *Earth dams, *Frozen soils, *Soil mechanics, *Soil tests, *Soil strength, *Compressive strength, *Tension, Tension cracks, On-site tests, Stress measurement, Strain measurement, Dams, Soviet Union, Comparison studies.

To solve the problem of tension cracking in earth dams the investigations should include: testing soil samples in a thawed and, as required, frozen state for determining the total yield surfaces with the establishment of the zones of failure of the soil by tension and shear, using instruments in which it is possible to accomplish independent loading by compressive and tensile forces; calculation of the stress-strain state of the dam; determination of the extent and spatial orientation of tension cracks; and establishment of the extent of open cracks. Such investigations were conducted on the crest and cores of two Soviet dams: one being constructed under northern conditions, with a height of 132 m, and one being planned for construction in the south, with a height of 330 m. The proposed method includes a number of assumptions that lead to the size of the zones of cracking being exaggerated. This is justified because it compensates for other aspects of the procedure, thus leading to a built-in factor of safety. The proposed approach to evaluating cracking can be used when solving problems of stability (considerations of zones of tension), when investigating the possibility of deformable foundations by tension within and outside the limits of support of the structures, when investigating failure by tension of the surfaces of undermined areas, and when determining pressures on a structure and in other cases in which the occurrence of zones of tension is possible in connection with loading of soils. (Rochester-PTT)
W89-04196

EXPERIENCE AND PROSPECTS OF USING VIBRATING ROLLERS IN HYDROTECHNICAL CONSTRUCTION,
For primary bibliographic entry see Field 8C.
W89-04232

GROUT CURTAIN IN THE FOUNDATION OF THE EARTH DAM OF THE MAINA HYDROELECTRIC STATION,
N. N. Zhurkina.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 650-655, May 1988. 3 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 39-42, November 1987.

Descriptors: *Earth dams, *Dam construction, *Dam foundations, *Grouting, *Hydroelectric plants, *Soviet Union, Concrete dams, Bedrock, Loam, Alluvial soils, Pressure head, Hydraulic permeability, Permeability coefficient, Construction methods, Construction costs.

The Maina hydro development includes right-bank, channel, and left-bank earth dams with a loam core, a spillway concrete dam, and a powerhouse. The loam core is joined with the bedrock (shale) by a grout curtain in fill and natural alluvial soils. The curtain was installed with a pressure head on the dam of up to 12.5 m under the protection of a temporary loamy sand blanket placed on natural alluvium; the blanket reduced the gradient of the head in the zone of grouting. The combined method of grouting (packerless, packer, and with a moving pipe) used made it possible to save materials and reduce the estimated cost of the curtain by 30%. The use of the packerless method of grouting can be recommended for barrier rows of the curtain when the initial permeability of the soil is greater than 100 m/day, in combination with the packer method of grouting the central rows. The new 'moving pipe' method tested at the Maina hydrostation showed results close to packer grouting and, consequently, possible usefulness. The results of control tests showed a high density of the grout curtain (permeability coefficient up to 0.5-1.0 m/day). The design of the packer strings with rubber packers flush with the pipe surface provided tightness and cleanness of the strings and is recommended for further use. Experience confirmed the expediency of placing a concrete covering, created by the separate concreting method, over the grouted area. (Shidler-PTT)
W89-04234

DETECTION OF SEEPAGE IN CRACKED DAMS,
Soil Conservation Service, Phoenix, AZ.
For primary bibliographic entry see Field 8G.
W89-04376

8E. Rock Mechanics and Geology

MAP SHOWING DEPTH TO BEDROCK, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-04037

GEOLOGIC RECONNAISSANCE OF AN EXTENSIVE CLAY UNIT IN NORTH-CENTRAL SUFFOLK COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-04082

SEISMIC LOADS ON THE FOUNDATIONS OF HYDRAULIC STRUCTURES DURING STRONG EARTHQUAKES,
L. A. Skorik.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 23-26, July 1988. 4 fig, 1 tab, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 22-25, January 1988.

Descriptors: *Data interpretation, *Hydraulic structures, *Earthquakes, *Seismic loading, *Soviet Union, *Dam foundations, Reservoirs, Chirkey Dam, Seismology, Accelerograms, Velocigrams, Computers.

Earthquakes occurring on January 10 and 13, 1975, 6 mo after the start of filling of the Chirkey (Soviet Union) Reservoir are described. The earthquakes, which had an intensity of 3-5 (scale of the Institute of Earth Physics, USSR Academy of Sciences) were recorded at the same observation point on a rock foundation near the Chirkey dam. Data of the horizontal and vertical components of the seismic oscillations were analyzed. Manual and computer processing was employed. For the accelerograms, practically coinciding values of the maximum intensities of seismic oscillations (Amax) with a period (Tmax) of 0.18 sec were obtained for the horizontal and vertical components. For the velocigrams, Amax = 2.6 cm/sec, with Tmax = 0.07 sec for the horizontal component and Amax = 3.4 cm/sec with Tmax = 0.07 sec for the vertical component. The spectra obtained with computer processing of the accelograms indicated that the maximum intensities of oscillations for the horizontal and vertical components lie in the same interval of frequencies 2-9 Hz, but for the horizontal component the maximum frequency at 0.2 Hz is absent and the entire spectrum is somewhat shifted into the high-frequency region. The machine spectra of the velocigrams for the horizontal component show maximum values in the interval 2-6 Hz and for the vertical in the interval 2-8 Hz. (Rochester-PTT)
W89-04195

PREVENTION OF THE DESTRUCTION OF THE STILLING BASIN OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04229

METHOD OF PREDICTING THE CHARACTERISTICS OF A ROCK MASS IN HYDROTECHNICAL CONSTRUCTION,
O. A. Pakhomov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 625-632, April 1988. 3 fig, 5 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 45-48, October 1987.

Descriptors: *Rock properties, *Construction materials, *Dam design, *Dam construction, *Earth dams, *Rock-fill dams, Prediction, Seepage, Rock testing, Soil tests, Compaction, Moisture content, Stress analysis, Strain measurement.

In preliminary stages of designing hydro developments and other hydrotechnical complexes where large earth/rock dams are to be constructed, an evaluation of their static, dynamic, and seepage strength is required. Therefore, it is necessary to know the characteristics of the physical and mechanical properties of the earth materials being used and their dependence on placement density, moisture content, and stress/strain state. The method proposed makes it possible to predict the characteristics of a rock mass when designing rockfill and earth/rock dams when there is minimum initial information about the rock properties. The empirical formulas presented were obtained by a mathematical analysis of the results of a large number of tests of real soils conducted with the use of large-scale testing equipment. This circumstance is a guarantee of the close correspondence between calculated and experimental data. The intended use of the method is the prediction of physical and mechanical characteristics with an accuracy sufficient for preliminary stages of designing earth structures. The results of engineering surveys will refine the predictions, but by this time they will already have played their useful role. The proposed method was used successfully by the Lengidroproekt and the Lengiprovodkhoz and could be used in the design of other projects. (Shidler-PTT)
W89-04230

SOLUTION PROCEDURE FOR THE EARTHQUAKE ANALYSIS OF ARCH DAM-RESERVOIR SYSTEMS WITH COMPRESSIBLE WATER,
Department of Water Affairs, Pretoria (South Africa).
J. P. F. O'Connor, and J. C. Boot.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 16, No. 5, p 757-773, July 1988. 11 fig, 20 ref.

Descriptors: *Earthquake engineering, *Model studies, *Dam design, *Reservoir design, *Model studies, Concrete dams, Dam-reservoir systems, Water load vectors, Hydrodynamic force, Arch dams, Mathematical analysis.

Two processes using the Newmark implicit integration scheme were used to analyze the earthquake response of a three-dimensional model for arch dam-reservoir systems including the effect of compressibility of the water. The solid structure and fluid regions are modelled separately, and the forcing functions at the interface are due to the hydrodynamic pressures from the reservoir acting on the upstream face of the dam wall, and the accelerations from the dam wall acting in turn on the reservoir. For the purposes of an initial investigation, elastic properties were assumed for the material of the dam: in the reservoir, radiation damping at the upstream boundary has been included, but bottom absorption has not. The excitation was provided by means of a combisweep which was fashioned so that its continuously varying frequencies pass through the fundamental frequencies of both the arch dam-reservoir system and the reservoir alone. Consequently the response is highly resonant, thus providing a severe test for the numerical procedures. From the numerical results obtained for an example problem it is concluded that both schemes provide an acceptable solution to the problem posed. It may be possible to enhance the system for more complex situations. (Author's abstract)
W89-04320

8F. Concrete

REPAIR WORKS FOR UPLIFT AND SEEPAGE CONTROL IN EXISTING CONCRETE DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 8G.
W89-03341

LEACHABILITY OF TECHNETIUM FROM CONCRETE,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung.
For primary bibliographic entry see Field 5B.
W89-03403

IMPROVEMENT OF THE METHOD OF CALCULATING THE STRENGTH OF REINFORCED-CONCRETE ELEMENTS ON THE BASIS OF INCLINED SECTIONS,
A. S. Zalesov, V. B. Nikolaev, and O. D. Rubin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 12, p 715-718, June 1988. 2 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 39-42, December 1987.

Descriptors: *Reinforced concrete, *Strength, *Hydraulic structures, *Materials engineering, Concrete construction, Building codes, Tensile stress, Compressive stress, Slopes, Design criteria, Reliability, Cost analysis, Mathematical studies, Soviet Union.

The calculation of strength of reinforced concrete elements, particularly on the basis of inclined sections, is examined with reference to two Soviet codes governing this type of work: SNiP 2.03.01-84 and SNiP II-56-77. Bending effects, longitudinal compressive and tensile forces, scaling factors, and assessment of the most dangerous inclined section are considered. Calculation of the strength of reinforced concrete elements on the basis of inclined sections with the consideration of the proposed changes in SNiP II-56-77, paragraph 3.25, provides an increase of reliability and cost effectiveness of hydraulic structures, which is especially important for structures to be operated for a long time. The calculations by the proposed method show a better agreement with the experimental with than by each separate SNiP 2.03.01-84 and SNiP II-56-77. The method requires further development to take into account all phenomena reflecting the resistance of reinforced-concrete elements to the effect of a combination of external loads Q (transverse) and N (longitudinal) and bending moments. (Rochester-PTT)
W89-04189

CONCRETE DAM OF THE BRATSK HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-04200

UPLIFT PRESSURE OF WATER IN A SYSTEM OF CRACKS OF ECCENTRICALLY COMPRESSED REINFORCED-CONCRETE ELEMENTS,
E. A. Kogan, and Y. B. Mgalobelov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 69-75, July 1988. 4 fig, 2 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 56-60, January 1988.

Descriptors: *Reinforced concrete, *Compression, *Water pressure, *Cracks, *Materials testing, Standards, Uplift, Forces, Stress, Design criteria.

Experiments were conducted to evaluate the effects of eccentric compression on large-scale elements with a cross section of 50 x 50 cm and a length of 2.5 m, which were subjected to the direct effect of water pressure on a segment of 0.7 times the length of the structure. In the tensioned zone equal to the depth of the cracks observed in the experiments, a rectangular water pressure diagram was first established, but after several days losses of pressure due to seepage along partially clogged cracks caused the diagram to become less rectangular and pore water pressure equal to 30-50% of the pressure head occurred in the compressed zone. Investigations of the reinforced-concrete elements under the effect of the uplift pressure of water in one crack showed that, in this case, the change in stresses in the reinforcement occurred only in the section along the crack and was of local character. Outside the zone of action of the water pressure its effect on the internal forces in the reinforced concrete element rapidly diminished to a length of 0.3-0.4 x the height. In the zone of action of water pressure encompassing a system of 7-9 normal cracks, changes in the stress state were observed mainly in sections along the extreme cracks. In the other sections the changes were 2-5 times less. The measured values of the increments of stresses in the reinforcement in sections along the extreme cracks (from the effect of a water pressure of 5-8 gauge atmospheres) were close to the calculated values of such increments obtained according to the existing standards. In conformity with these standards, these increments should be taken into account in any section of non-crack-resistant reinforced concrete elements. The values of the stresses in the reinforcement obtained from experiments differ substantially from the calculated values obtained both with and without consideration of the water pressure. (Rochester-PTT)
W89-04203

ENLARGEMENT OF CONCRETE BLOCKS OF ARCH DAMS WITH ALLOWANCE OF THE FORMATION OF RADIAL THERMAL CRACKS,
G. P. Verbetskii, G. I. Chogovadze, and A. I. Daneliya.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 633-636, April 1988. 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 49-51, October 1987.

Descriptors: *Concrete technology, *Arch dams, *Construction methods, *Temperature effects, *Cracks. Concrete construction, Concrete dams, Hydraulic structures, Hydrostatic pressure, Compressive strength, Construction costs.

Using modern highly-productive continuous-concreting techniques, considerable acceleration of the construction of arch dams is possible by increasing the block size and by allowing them to form thermal radial cracks. Theoretical analysis and on-site observations show that hydrostatic pressure causes radial joints and cracks in compressed zones of an arch dam to close and these parts of the dam then work as a solid unit. Twenty-five years of experience in designing and constructing concrete and reinforced-concrete hydraulic structures which allow the formation of cracks of limited opening shows that cracks can also be allowed in arch dams without compromising the durability of the concrete. Thermal cracking which lengthens along the faces of the dam should be controlled by making stress-concentrating radial notches which encourage the formation of radial cracks at prescribed places. With the controlled formation of thermal radial cracks, the size of the blocks in the faces of an arch dam is not limited by the requirement for crack resistance; it is determined by the rate at which concrete can be poured and other construction constraints. The technical and economic benefits from concreting arch dams by this process result from acceleration of dam construction and reduction of material and labor expenditures on constructing forms, preparation of the blocks, and grouting the joints. (Shidler-PTT)
W89-04231

WATER REQUIREMENT OF CONCRETE MIXES,
N. K. Bugaeva, and L. M. Deryugin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 670-672, May 1988. 3 fig, 1 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 52-53, November 1987.

Descriptors: *Concretes, *Concrete mixes, *Concrete testing, *Water requirements, Concrete technology, Concrete construction, Materials testing, Strength, Aggregates, Sand, Gravel, Portland cements.

Most modern methods of determining the compositions of concrete mixes are based on certain generally-accepted principles, one of which is the so-called law of constancy of the water requirement. This implies that, given a constant quantity and quality of coarse aggregate and an amount of cement between the approximate limits of 150 and 350 kg/cubic m, a constant proportion of water is required to ensure constant fluidity of the concrete mix. The purpose of the study was to determine the water requirement of concrete mixes for the most common cement quantities, cement types, aggregate sizes, etc., used in construction projects. Sand and gravel obtained by sorting the sand/gravel mix of the Oznachennoe quarry and Portland cement of grade 400 and Portland blast-furnace cement of grade 300 from the Krasnoyarsk cement plant were used for the mixes. The relation between the amount of water and the amount of cement was found to be nonlinear. A minimum amount of water was needed for an amount of cement of about 300 kg/cubic m concrete mix. This must be taken into account when proportioning concrete. The strength of concrete was likewise shown to be dependent on the water/cement ratio. Concrete strength was also dependent on the amount of cement; an increase of fluidity by 2-4 cm led to a noticeable decrease of the concrete strength (20-40 kg/square cm). (Shidler-PTT)
W89-04238

8G. Materials

REPAIR WORKS FOR UPLIFT AND SEEPAGE CONTROL IN EXISTING CONCRETE DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. O. Pedro.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 385. Price codes: A03 in paper copy, A01 in microfiche. First Interim Report, October 1987. 14p, 2 append.

U.S. Army Contract DAJA45-87-C-0022.

Descriptors: *Concrete dams, *Dam stability, Hydromechanics, Concrete, Maintenance, Materials testing, Gravity dams, Foundation failure.

Deteriorations of foundations of concrete dams were studied in three main steps: (i) analysis of case histories on the deterioration of foundations of some Portuguese arch dams and on the behavior of some Portuguese gravity dam foundations; (ii) study of the hydromechanical behavior using mathematical and experimental methods; and (iii) studies on the materials and techniques used for the repair works in concrete dam foundation. An associate investigator from U.S. Army Waterways Experimental Station visited in the 2nd week of September. The report of the visit is appended to this report. Additional information is included on the planning of the work should be divided into four technical reports, to be included in the final report. Draft lists of the items to be developed in each report as well as a general plan for the activities are also appended. (See also W89-03341) (Lantz-PTT)
W89-03339

REPAIR WORKS FOR UPLIFT AND SEEPAGE CONTROL IN EXISTING CONCRETE DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. O. Pedro.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A191 384. Price codes: A02 in paper copy, A01 in microfiche. Second Interim Report, December 1987. 3p. U.S. Army Contract DAJA45-C-0022.

Descriptors: *Concrete dams, *Dam maintenance, *Maintenance, Model studies, Case studies, Gravity dams, Hydromechanics, Foundation failure.

This interim report presents a summary of the work done and of the administrative actions carried out in the period concerned, under the terms of the contract, as well as some comments on future work. The report will refer to each of the four main steps that are planned for the development of the work, namely: (1) Case histories on rock mass foundation deteriorations of some Portuguese arch dams; (2) Case histories on the hydromechanical behavior of some Portuguese concrete gravity dam foundations; (3) Modelling of the hydromechanical behavior of concrete dam foundations; and (4) Tests for deterioration evaluation and for analysis of repair works in concrete dam foundations. (See also W89-03339) (Lantz-PTT)
W89-03341

DEVELOPMENT OF METHODOLOGY FOR RETROFITTING WATER LIFELINES FOR IMPROVED SEISMIC RESISTANCE,
Environmental Quality Systems, Inc., Rockville, MD.
J. Scalzi.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-206249. Price codes: A06 in paper copy, A01 in microfiche. Report No. NSF/ENG-85082, March 1985. 185p, 34 fig, 8 tab, 95 ref. NSF Grant CEE-8011189.

Descriptors: *Earthquake engineering, *Pipelines, *Water supply systems, *Water conveyance, *Earthquake engineering, Earthquakes, Costs, Design standards, Construction, Hydraulic structures, Seismic properties.

A methodology is developed to evaluate and apply retrofitting procedures to provide seismic protection to existing water systems in the United States. This report is concerned with the seismic protection of existing water lifeline systems (i.e., post-construction measures). The study includes a review of historical data on water system damage and failures caused by earthquakes. Existing codes and seismic evaluation methods for building and/or utilities were reviewed for application to existing water system. Potential retrofitting techniques and associated preliminary designs are identified. Emphasis is on the utilization of the existing state-of-the-art knowledge of earthquake forces to develop a methodology for evaluating water system impacts and identifying methods to mitigate or minimize damage to critical systems. Cost factors for implementation of the retrofit techniques are identified in an effort to emphasize the cost/benefit principles involved in planning a retrofit program. (Author's abstract)
W89-03347

WAYS TO CREATE AND IMPROVE HIGH-PARAMETER HYDRAULIC DRIVES FOR HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8C.
W89-04181

INTERPRETATION OF THE RESULTS OF SHEAR TESTS OF SANDS,
For primary bibliographic entry see Field 8D.
W89-04188

SELECTION AND INVESTIGATION OF SUPPORTS OF THE UNDERGROUND GENERATOR HALL OF THE ROGUN HYDROELECTRIC STATION,
O. N. Zolotov, V. F. Ilyushin, and V. M. Mostkov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 6-12, July 1988. 9 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 11-15, January 1988.

Descriptors: *Hydroelectric plants, *Underground powerplants, *Design analysis, *Soviet Union, *Structural engineering, *Materials engineering, *Earthquake engineering, Rogun Hydroelectric Station, Comparison studies, Geologic fractures, Reinforced concrete, Tectonic stress, Compressive stress, Yielding structures, Construction joints, Deformation.

The underground powerhouse of the Rogun Hydroelectric Station (Soviet Union) currently being constructed is located in the upper pool at a depth up to 420 m below the ground surface in a single tectonic block bounded by two active faults. The roofs of the workings are to be supported by reinforced-concrete arches and the walls with prestressed rock bolts. Because a preliminary analysis suggested that the customary rigid construction would not withstand the compressive stresses occurring and would be destroyed, six variant schemes, each using different numbers and locations of longitudinal deformation joints, was employed. A series of different representations of the stress-strain structure was drawn on a plotter for each of the calculated cases. The use of a yielding structure of the arch of the generator hall provides reliable support under conditions of large tectonic stresses. The proposed structure results in a reduction of the volume of works on rock excavation and underground reinforced concrete resulting from reducing the thickness of the arch to 0.7 m. An essential element of the yielding arch is the deformation joint, which yields in the axial direction, but is sufficiently rigid in the transverse direction. (Rochester-PTT)
W89-04192

REDUCTION OF THE DAMAGEABILITY OF WATERTIGHT POLYMER-FILM SKINS OF HYDRAULIC STRUCTURES,
V. A. Melent'ev, and A. P. Chumaganov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 1, p 13-16, July 1988. 3 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 16-18, January 1988.

Descriptors: *Construction methods, *Thin films, *Hydraulic structures, *Materials engineering, *Damage, Leakage, Deterioration, Liners, Geotextiles, Bituminous liners, Design criteria, Polymers, Waterproofing.

On-site investigations were conducted of the damageability of polymer-film skins on hydraulic structures and measurements of leakage by seepage made it possible to estimate the apparent permeability for such skins with relatively small damageability ($P = < or = 0.05\%$, where the damageability $P = 100\ W/F$, where W is the total area of all damages and F is the examined area of the skin). Maximum damageability of polymer-film skins results from the use of machines--bulldozers leveling the protective layer and vehicles delivering these soils. Introduction of means of placing the protective layer of soil on the film element without traveling on the skin makes possible substantial reduction in the damageability and permeability of polymer-film skins. Reduction of damageability and permeability can be achieved particularly by introducing bituminous and geotextile pads covering the film element or the skin on top and below, introduction of a second layer of film covering, and by providing a drainage system for the protective layer. (Rochester-PTT)
W89-04193

STRENGTH OF THAWED AND FROZEN SOILS OF DAM CORES UNDER CONDITIONS OF TRIAXIAL INDEPENDENT LOADING BY TENSION AND COMPRESSION,
For primary bibliographic entry see Field 8D.
W89-04196

UPLIFT PRESSURE OF WATER IN A SYSTEM OF CRACKS OF ECCENTRICALLY COMPRESSED REINFORCED-CONCRETE ELEMENTS,
For primary bibliographic entry see Field 8F.
W89-04203

IMPROVEMENT OF THE METHOD OF CALCULATING SAFE DISTANCES IN UNDERWATER EXPLOSIONS,
V. A. Fokin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 11, p 646-649, May 1988. 2 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 37-39, November 1987.

Descriptors: *Construction methods, *Mathematical equations, *Explosions, *Safety, Dredging, Demolition, Explosives, Pressure distribution, Hydraulic engineering.

The explosion of underwater concentrated charges is finding ever-greater use in hydrotechnical construction practice. Pressure charges are useful for dredging operations as well as for destroying underwater structures. One of the factors substantially affecting the safety of the water area when conducting such explosions is a correct determination of the safe distance as a function of the mass of the charge and type of explosive used. In connection with this, a method is examined which permits determining the numerical values of A, K, and alpha (empirical coefficients characterizing the rate of change in pressure relative to the distance covered by the pressure wave) for arbitrary initial conditions inherent in the use of industrial explosives. The approach to the solution of the stated problem is based on a generalization and analysis of the already available separate experimental data on individual types of explosives and establishment of new empirical rules characterizing the interrelation of coefficients A, K, and alpha as parameters of a single physical process. Thus, it is possible to determine with an accuracy sufficient for practical use the safe distance under various initial blasting conditions, which considerably simplifies the engineering calculations and increases their reliability when designing industrial explosions. (Shidler-PTT)
W89-04233

SOLUTION PROCEDURE FOR THE EARTHQUAKE ANALYSIS OF ARCH DAM-RESERVOIR SYSTEMS WITH COMPRESSIBLE WATER,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 8E.
W89-04320

DETECTION OF SEEPAGE IN CRACKED DAMS,
Soil Conservation Service, Phoenix, AZ.

R. M. Arrington.
Transactions of the ASAE TAAEAJ, Vol. 31, No. 3, p 701-705, May-June 1988. 10 fig.

Descriptors: *Seepage, *Dams, *Earth dams, *Cracks, *Monitoring, Excavation, Maintenance, Filters, Wetting, Piezometers, Embankments, Design criteria, Soil conservation, Geology, Arizona.

During repair of the Vineyard Road Floodwater Retarding Structure, Arizona, cracking was found to be considerably more extensive than was predicted during the investigation and design of the repair. Cracks extended to the foundation and had openings to 4 cm wide and frequently at 2 m intervals. Seepage through this cracked embankment was studied in four rectangular cells built within the reservoir. Two of the cells were test embankments in repaired conditions, one was in an unrepaired condition and the fourth had an impervious geomembrane in place along the downstream trench face. Piezometers were installed in each cell at locations of known cracks. After piezometer placement, the cells were filled for 30 days. The seepage within the cracks of this embankment was self healing and little or no advance of the phreatic line occurred. The cracked embankment appears to be safe against seepage and subsequent failure. (Stoehr-PTT)
W89-04376

8H. Rapid Excavation

INCREASE OF THE EFFECTIVENESS OF HYDROPOWER CONSTRUCTION EXEMPLIFIED BY THE BLAST-FILL DAMS OF THE KAMBARATA HYDROELECTRIC STATIONS,
V. F. Korchevskii, M. F. Burshtein, and G. N. Petrov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 10, p 611-619, April 1988. 2 fig, 3 tab, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 33-38, October 1987.

Descriptors: *Rapid excavation, *Explosives, *Dam construction, *Construction methods, *Hydroelectric plants, *Soviet Union, Water resources development, Rockfill dams, Dam design, Design standards, Project planning, Future planning.

The construction of dams by directed blasting is one of the new directions in Soviet hydrotechnical construction. A complex program of investigations was developed in the early 1970s, the end goal of which was the creation of scientifically-founded standards for designing dams constructed by blasting. Planning and construction priority was given to the Kambarata hydroelectric stations on the Naryn River in the Kirgiz SSR. According to calculations construction of the Kambarata No. 1 hydrostation dam, with a height of 275 m, length along the channel of 2000 m, and profile volume of 112 million cubic m, would require 260,000 tons explosive and the total volume of the blasted pile of rock would be 440 million cubic m. Igdanite, a mixture of ammonium nitrate and diesel fuel, was determined to be the most suitable explosive. These results were used also for designing the Kambarata No. 2 hydrostation. Design studies for future projects show that blast-fill dams can be used successfully for constructing the Karabulun hydrostation on the Naryn River, the Susamyr hydrostation on the Kokomeren River, a cascade of hydrostations on the Pyandzh River, the Kafkarguzar hydrostation on the Odi-Kingou River, the Barkrak hydrostation on the Chatkal River, Aravan hydro development on the Aravan River, and others. (Shidler-PTT)
W89-04227

8I. Fisheries Engineering

STRATEGIES AND DIFFICULTIES OF APPLYING MODELS TO AQUATIC POPULATIONS AND FOOD WEBS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7B.
W89-03355

EFFECTS OF SEA CAGE SALMON FARMING ON SEDIMENT NITRIFICATION AND DISSIMILATORY NITRATE REDUCTIONS,
Cawthron Inst., Nelson (New Zealand).
For primary bibliographic entry see Field 6G.
W89-03477

INUNDATED TIMBER AS NURSERY HABITAT FOR LARVAL GIZZARD AND THREADFIN SHAD IN A NEW PUMPED STORAGE RESERVOIR,
Georgia Cooperative Fishery and Wildlife Research Unit, Athens.
M. J. Van Den Avyle, and R. W. Petering.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 1, p 84-89, January 1988. 2 fig, 1 tab, 29 ref.

Descriptors: *Fisheries, *Reservoir fisheries, *Larvae, *Pumped storage, Reservoirs, Shad, Fish eggs, Invertebrates, Timber, Lake Oconee, Georgia.

Influences of inundated timber on distribution of larval fishes were evaluated during April-August 1982 in Lake Oconee, Georgia, by determining densities of larvae in 2 offshore timber plots and 2 adjacent open-water areas. Most (97%) of the larvae collected were gizzard shad (Dorosoma cepedianum) and threadfin shad (D. petenense), and these species were usually more abundant in or near the flooded timber than in nearby limnetic sites. Larvae of other fishes, including Lepomis spp., Pomoxis spp., and white bass (Morone chrysops), were rarely collected but occurred primarily at timbered sites. Higher abundance of larvae in the timber may reflect both extensive use of the flooded trees as spawning substrates and increased availability of food or shelter. Invertebrates and fish eggs collected incidentally during sampling for larvae were more abundant at timbered sites. (Author's abstract)
W89-03528

SALMON RIVER HABITAT ENHANCEMENT. ANNUAL REPORT: FY 1986, PART 1,
Shoshone-Bannock Tribal Fisheries Dept., Fort Hall Reservation, ID.
C. Richards, and P. J. Cernera.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-003276. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/BP/14383--3, March 1987. 109p, 37 fig, 22 tab, 20 ref. DOE Contract DE-A179-84BP14383. Project 83-359.

Descriptors: *Sediment control, *Water resources development, *Salmon River, *Ecological effects, Trout, Salmon, Aquatic environment, Ecosystems, Sedimentation, Bear Valley Creek, Population density, Species diversity, Fish, Spawning.

Fine sediments from an inactive dredge mine (4.5 km) near the headwaters of Bear Valley Creek Idaho have covered spawning gravels and filled in rearing habitat of chinook salmon and steelhead trout in the stream from the mid-1950's to 1986. Habitat enhancement efforts via a project funded by Bonneville Power Administration have begun to decrease sediment recruitment from reaches within the mined area. The effects of reduced sediment recruitment will be evaluated by monitoring aquatic habitat and fish communities over time. Physical (1 time/yr 1984 and 1985) and biological (2 times/yr 1984, 85 and 86) variables were measured in seven sites within each of seven strata along the length (55 km) of Bear Valley Creek. In 1986 fish species present in Bear Valley Creek were chinook salmon, mountain whitefish, steelhead/rainbow trout, brook trout, cutthroat trout, bull trout, and shorthead sculpin. Significant differences in densities were observed in July and August among strata with age 0+ chinook salmon, adult whitefish and brook trout. Length, weight and condition of age 0+ chinook salmon was greatest in the most downstream stratum and decreased in an upstream direction. This corresponds to general trends in stream temperature. Significant differences in densities among years were observed in, age 1+ chinook salmon, steelhead trout age 0+ and 2+, whitefish age 0+ and bulltrout. A significant association between years and strata was noted in the distribution of age 0+ chinook salmon. The largest shift was in 1986 when no fish were found in the uppermost strata. This contrasts with 1985 and 1984 when 40% and 12% respectively were found in stratum 6 and 15% and 18% were found in stratum 5. During 1986 the relative composition of age 0+ chinook salmon ranged from 0 to 80% among strata. (Author's abstract)
W89-03747

RESPONSE OF YOUNG-OF-THE-YEAR CUTTHROAT TROUT TO MANIPULATION OF HABITAT STRUCTURE IN A SMALL STREAM,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W89-03849

FISH DENSITY VARIATIONS IN THE BRAIDED ASHLEY RIVER, CANTERBURY, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Christchurch (New Zealand). Freshwater Fisheries Centre.
For primary bibliographic entry see Field 2H.
W89-03858

COMPARATIVE STREAM RESIDENCE OF JUVENILE BROWN AND RAINBOW TROUT IN A SMALL LAKE TRIBUTARY, SCOTTS CREEK, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-03863

LONG-TERM CORRELATIONS BETWEEN THE ABUNDANCE OF SMELT, (OSMERUS EPERLANUS EPERLANUS L.), YEAR CLASSES AND ABIOTIC ENVIRONMENTAL CONDITIONS DURING THE PERIOD OF SPAWNING AND LARVAL DEVELOPMENT IN THE ELBE RIVER,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 2H.
W89-03973

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN ILLINOIS, 1987,
Geological Survey, Urbana, IL. Water Resources Div.
M. L. Garrelts.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-698, 1988. 116p, 7 fig, 3 tab, 2 ref.

Descriptors: *Data collections, *Hydrologic data, *Information transfer, *Illinois, Water resources data, Hydrologic data.

Water resources investigations of the U.S. Geological Survey in Illinois consist of collecting hydrologic data and making interpretative investigations. The data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. This report describes the data-collection activities and investigations in Illinois during the 1987 fiscal year (October 1, 1986 - September 30, 1987) and provides an extensive list of publications pertaining to the water resources of Illinois. (USGS)
W89-04044

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NORTH DAKOTA, FISCAL YEAR 1986,
Geological Survey, Bismarck, ND. Water Resources Div.
C. R. Martin.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-530, 1987. 100p, 11 fig, 4 tab.

Descriptors: *North Dakota, *Water resources projects, *Water quality, *Hydrologic data collections, *Data collections, Groundwater data, Surface water, Information exchange, Hydrology.

This report was prepared to inform interested Federal, State, and local agencies and private individuals of the activities of the Water Resources Division in the State. All ongoing water-resources projects in North Dakota in fiscal year 1986 are listed. Information on each project includes objectives, approach, progress in 1985, plans for 1986, completed and planned report products, and the name of the project chief. (USGS)
W89-04047

SUMMARY OF WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN COLORADO, FY 1987,
Geological Survey, Lakewood, CO. Water Resources Div.
J. M. Stewart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 25425. USGS Open-File Report 87-388, 1987. 65p, 1 fig, 1 tab.

Descriptors: *Hydrologic data, *Water quality data, *Surface water, *Data collections, *Colorado, Groundwater resources data, Information transfer.

The annual summary of water-resources activities in Colorado is presented for fiscal year 1987. The report includes an introduction of these activities and names of the management personnel to whom information requests may be addressed; a summary of the U.S. Geological Survey mission and of the Water Resources Division mission; and a discussion of the water resources in Colorado in fiscal year 1987, including data collection on surface water and groundwater. All current Colorado hydrologic investigations are listed - their problems, objectives, approaches, progress, and plans for fiscal year 1987. A list of current cooperators for fiscal year 1987 and a list of reports published or released during fiscal year 1987 also are given. (USGS)
W89-04124

WATER RESOURCES ACTIVITIES IN FLORIDA, 1986-87,
Geological Survey, Tallahassee, FL. Water Resources Div.
M. E. Glenn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-244, 1987. 98p, 11 fig.

Descriptors: *Water resources projects, *Data collections, *Information transfer, *Florida, Water resources.

This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1986-87. These activities are part of the Federal program of appraising the Nation's water resources. (USGS)
W89-04134

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT IN THE 1986 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
C. A. Griner, and P. W. Anttila.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-236, 1987. 97p, 6 fig, 4 ref.

Descriptors: *Groundwater resources, *Information transfer, *Data collections, *Hydrologic studies, *California, Mudflow hazards, Wastewater reuse, Water quality, Hydrologic data, Water resources data.

This report summarizes the progress of water resources studies in California by the U.S. Geological Survey during the fiscal yr 1986. Much of the work was done in cooperation with State and local agencies. Additional supporting funds were transferred from other Federal agencies or appropriated directly to the Geological Survey. The water resources program in California consisted of 42 projects. Each project is briefly described. Brief descriptions are given of the origin of the U.S. Geological Survey and the Water Resources Division's basic mission. An abbreviated organizational structure of the California District, sources of funding, a summary of water conditions, and a listing of reports published during fiscal year 1986 are also included. (USGS)
W89-04137

WATER RESOURCES INVESTIGATIONS IN TENNESSEE: PROGRAMS AND ACTIVITIES OF THE U. S. GEOLOGICAL SURVEY, 1986-87,
Geological Survey, Nashville, TN. Water Resources Div.
F. Quinones, B. H. Balthrop, and E. G. Baker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-231, 1987. 47p.

Descriptors: *Groundwater data, *Surface water data, *Water quality, *Suspended sediments, *Water use, *Flood frequency, *Tennessee, Data collections, Hydrologic data.

This report contains a summary of 30 projects which were active in the Tennessee District during 1986 or 1987. Each summary includes the name of the project chief, the objective of the project, the progress or results of the study to date, and the name of the cooperator. (USGS)
W89-04139

WATER RESOURCES ACTIVITIES IN ILLINOIS, 1986,
Geological Survey, Urbana, IL. Water Resources Div.
M. L. Garrelts.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-39, 1987. 119p, 11 fig, 3 tab, 4 ref.

Descriptors: *Water resources data, *Data collections, *Hydrologic data, *Illinois, Surface water, Groundwater, Water quality.

Water resources investigations of the U.S. Geological Survey in Illinois consist of collecting hydrologic data and making interpretative investigations. The data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. This report describes the data collection activities and investigations in Illinois during the 1986 fiscal year and provides an extensive list of publications pertaining to the water resources of Illinois. (USGS)
W89-04149

ACTIVITIES OF THE ALASKA DISTRICT, WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, 1987,
Geological Survey, Anchorage, AK. Water Resources Div.
E. F. Snyder.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-38, 1987. 24p.

Descriptors: *Water resources data, *Data collections, *Hydrologic data, *Hydrologic data collections, *Alaska, Hydrology, Project planning, Bibliographies, Data storage and retrieval.

Hydrologic data collection activities by the U.S. Geological Survey in Alaska are described. Seventeen projects were active in 1987. Each description includes information on period of project, project chief, funding sources, location, purpose, current status, and published or planned reports. The compilation also contains a bibliography of reports published by the Alaska District from 1984 through 1986. (USGS)
W89-04150

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY MID-ATLANTIC DISTRICT 1984-1986,
Geological Survey, Towson, MD. Water Resources Div.
L. J. McGreevey, G. J. Hyatt, and E. J. Cockey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-490, 1986. 129p, 11 fig.

Descriptors: *Hydrologic data, *Data collections, *Virginia, *Maryland, *Delaware, *District of Columbia, Surface waters, Groundwater, Water quality.

The Mid-Atlantic District of the U.S. Geological Survey, Water Resources Division, includes the States of Delaware, Maryland, and Virginia and the District of Columbia. The water resources program of the Mid-Atlantic District is conducted from offices located at seven sites in the three states. The program consists of two elements: Collection of basic records concerning quantitative and qualitative data for streams, reservoirs, estuaries, and groundwater; and interpretative investigations based on the water facts collected in the basic data activities. The organization and activities of the Mid-Atlantic District are described. Projects that were active during 1984, 1985, or 1986 are summarized with a listing of reports of results of water resources studies in the District that were approved between January 1980 and June 1986. (USGS)
W89-04155

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1987 PROGRAM REPORT (NEW JERSEY CENTER FOR COASTAL AND ENVIRONMENTAL STUDIES),
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
A. McIntosh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88 253323. Price codes: A03 in paper copy, A01 in microfiche. Division of Water Resources, Program Report G-1437-08. July 1988. 17p. Contract No. 14-08-0001-G-1437. Project No. USGS G1437-08.

Descriptors: *Water Research Institute, *New Jersey, *Research, *Information transfer, *Training, Education, Projects.

The 1987 New Jersey Section 104 program focused on two major issues currently facing the state: contamination of surface and groundwater by organic and inorganic substances and acidic deposition. Three projects focused on contaminants in surface and groundwater; research topics included the transport of organic contaminants in subsurface systems; movement of heavy metals in surface and groundwaters; and toxicity of dioxins associated with sediments. Two projects concentrated on acidic deposition, with one assessing sulfate reduction in the acidic New Jersey Pinelands and a second determining the composition of biological communities of a clearwater lake in northwestern New Jersey. Major information transfer activities included production of a Newsletter and an Annual Meeting. (USGS)
W89-04128

FISCAL YEAR 1987 PROGRAM REPORT (PUERTO RICO WATER RESOURCES RESEARCH INSTITUTE).
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.

Available from National Technical Information Service, Springfield, VA 22161 as PB89 1005801/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1446-01, July 1988. 21p. Contract No. 14-08-0001-G-1446. Project No. USGS G-1446-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Puerto Rico, Education, Projects.

Four research projects were sponsored with the 1987 Institute's grant. A study was conducted on the optimization of chlorination parameters in drinking water to reduce trihalomethane formation while providing adequate disinfection. Another study compared different methods for the enumeration of fecal bacteria in their application to tropical waters. All of them were found unacceptable, since they seem to grossly over-estimate the degree of fecal contamination on tropical waters. A third project evaluated the content attitude of water-related issues in Puerto Rico's daily newspapers. The content issue most frequently mentioned was pollution followed by water rates. The Puerto Rico Aqueduct and Sewerage Authority has become an issue of public concern. The fourth project is related to the potential development, as a tourist attraction, of a historic 19th century storm sewer system, consisting of attractive vaulted brick tunnels, which runs beneath downtown San German, the second oldest settlement in the Island. The tourism potential of this tunnel is hindered by flash floods during storm events, the illegal sewage discharges to it, and the threat of collapse of certain sections of the structure. A total of 18 students (11 undergraduate and 7 graduate) participated with the investigators in the execution of these projects. (del Valle-. Puerto Rico, WRRI)
W89-04352

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

RECENT ADVANCES IN ODOR POLLUTION ABATEMENT: A COMPUTER SEARCH,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5D.
W89-03380

10C. Secondary Publication And Distribution

CURRENT WATER RESOURCES ACTIVITIES IN ARKANSAS, 1986-87,
Geological Survey, Little Rock, AR. Water Resources Div.
B. L. Louthian, and E. E. Gann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-338. June 1988. 59p, 7 fig, 2 tab.

Descriptors: *Hydrology, *Data collections, *Hydrologic data, *Arkansas, Water use, Groundwater, Surface water, Water quality, Hydrologic studies.

This report describes water resources activities conducted by the Arkansas District of the U.S. Geological Survey, Water Resources Division during fiscal years 1986 and 1987. Activities included surface water, groundwater, water quality, and water-use investigations. Eighteen projects were funded during 1986 and 1987. For each project, a description of the project objectives, approach, plans and reports is included. Lists are included of reports completed during the period and of reports previously published by, or in conjunction with, the Geological Survey. (USGS)
W89-04032

OKLAHOMA, A SUMMARY OF ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, IN FISCAL YEARS 1986-87,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-172, 1988. 141p, 9 fig, 3 tab, 288 ref.

Descriptors: *Oklahoma, *Information exchange, *Bibliographies, Water resources development, Surface water, Groundwater, Documentation, Water resources research.

The activities of the Oklahoma District, Water Resources Division, U.S. Geological Survey are summaried for fiscal years 1986-87. Included are summary statements of current and recently completed projects, alphabetical and numerical listings of surface-water stations, and a bibliography of Oklahoma reports. (USGS)
W89-04038

SELECTED LITERATURE ON WATER-RESOURCES INVESTIGATIONS IN NEW JERSEY BY THE U. S. GEOLOGICAL SURVEY, THROUGH 1986,
Geological Survey, Trenton, NJ. Water Resources Div.
F. L. Schaefer.
Available from OFSS, USGS Box 25425, Denver, CO 80225. USGS Open-File Report 87-767, 1987, 45p, 1 fig.

Descriptors: *Bibliographies, *Water resources, *Hydrology, *Maps, *Publications, New Jersey, Literature, Reports, Water quality, Surface water, Groundwater, Floods, Drought, Geology, Water supply, Computer models, Land use, Aquifers, Rivers, Sediment.

Because of the importance and complexity of the water resources of New Jersey today, there is a need for a current bibliography to serve as a basis for future water resources studies. This report lists about 400 book reports, map reports, and articles that deal with the water resources of New Jersey published through 1986. The publications are grouped under three major headings: (1) publications of the U.S. Geological Survey, (2) publications of State agencies prepared by or in cooperation with the U.S. Geological Survey, and (3) other publications, such as technical journals prepared by or co-authored by U.S. Geological Survey personnel. Most of the publications are available for inspection at the West Trenton office of the U.S. Geologic Survey and at large public and university libraries. Ordering information is given for those publications that are for sale. (USGS)
W89-04043

WATER RESOURCES REPORTS PREPARED BY THE U.S. GEOLOGICAL SURVEY, TEXAS DISTRICT, 1973-86,
Geological Survey, Austin, TX. Water Resources Div.
G. J. Sladek.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-228, 1987. 40p, 1 ref.

Descriptors: *Bibliographies, *Water resources research, *Hydrologic data, *Texas, Data collections, Water resources.

This compilation is a bibliography of approximately 300 water resources reports written by personnel of the Texas District, Water Resources Division, U.S. Geological Survey, during 1973-86. The reports were approved and published in various U.S. Geological Survey report series and some reports also were published in report series of cooperating agencies. In addition to the bibliographic list, the reports are indexed by author. This compilation is a continuation of a previous report which listed reports released and published during 1887-1974. (USGS)
W89-04141

SUBJECT INDEX

ABSORPTION
Intestinal Nutrient Absorption - A Biomarker for Deleterious Heavy Metals in Aquatic Environments,
W89-03627 5A

ACCRETION
Poverty Bay, New Zealand: A Case of Coastal Accretion 1886-1975,
W89-03862 2L

ACCUMULATION
Sediment and Elemental Assimilation Rates in the Krishna River Basin, India,
W89-03948 2J

ACID MINE DRAINAGE
Sediment Chemistry of Lakes Formed by Surface-Mining for Coal in the Midwestern U.S.A.,
W89-03589 2H

Review of Experimental Additions of Rhodamine WT Dye into Reactive Aquatic Environments,
W89-03612 5B

Quality of Water in Mines in the Western Middle Coal Field, Anthracite Region, East-Central Pennsylvania,
W89-04120 5B

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

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